JANUARY 1957

Power Engineering

Annual Review of WORLD POWER DEVELOPMENTS

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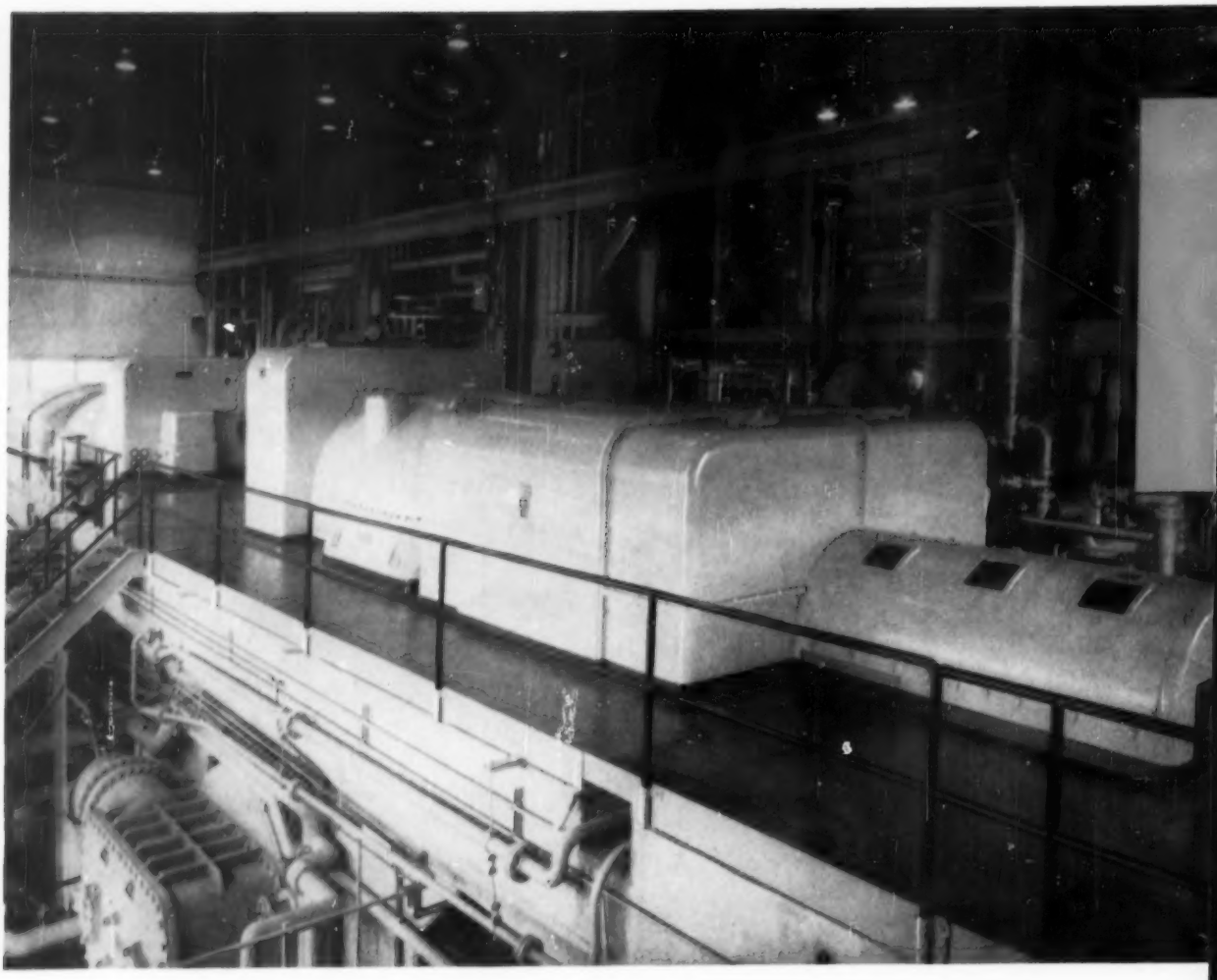
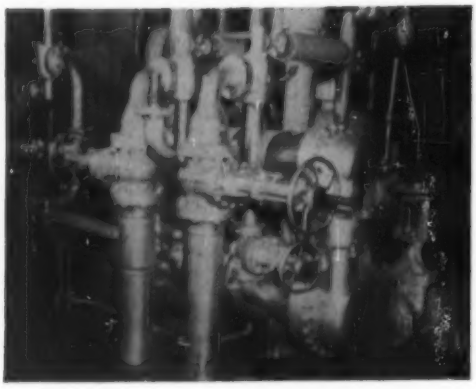
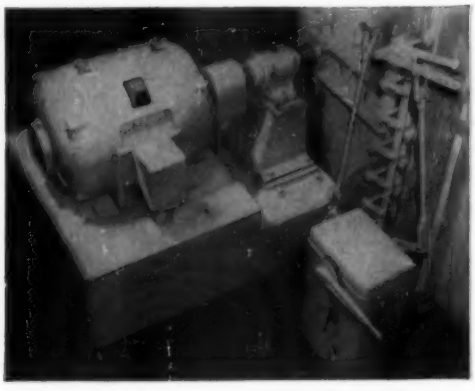




An Elliott twin two-stage steam jet ejector serves the condenser. Ejector is equipped with air leakage meter.



The forced-draft fan is driven by an Elliott C-W 150-hp, 1160-rpm motor.

ELLIOTT Company

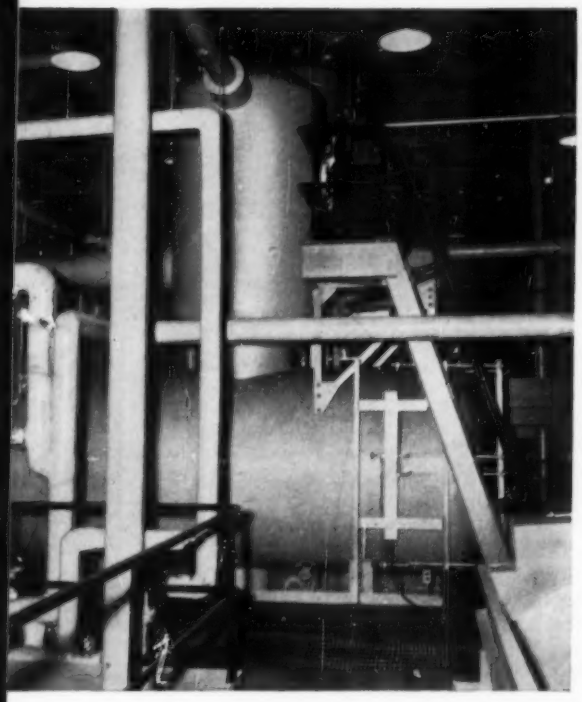
STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS
CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

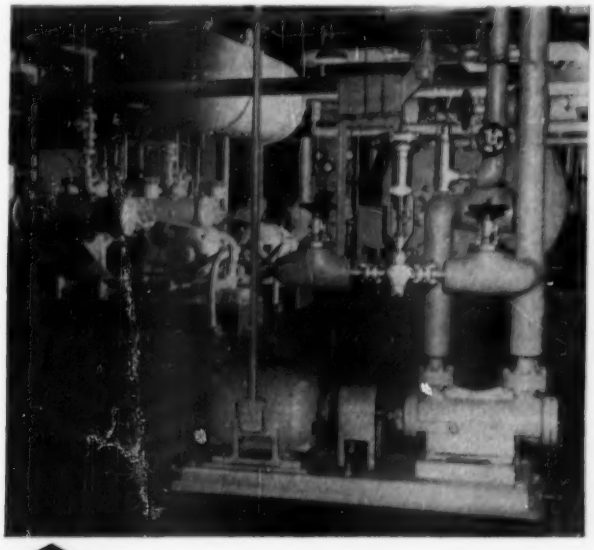
SECOND ELLIOTT UNIT installed at CARIBOU . . .

When Maine Public Service Company decided to expand the generating facilities of their Caribou Power Center, they had the benefit of four years of experience with Elliott equipment to guide them in the selection of turbine generator, condenser and auxiliaries for Unit No. 2. The equipment shown on these pages is all installed in Unit No. 2, and is evidence of the satisfactory performance of the Elliott machines in Unit No. 1.

Complete information on Elliott equipment may be obtained from our nearest District Office, or from Elliott Company, Jeannette, Pa.

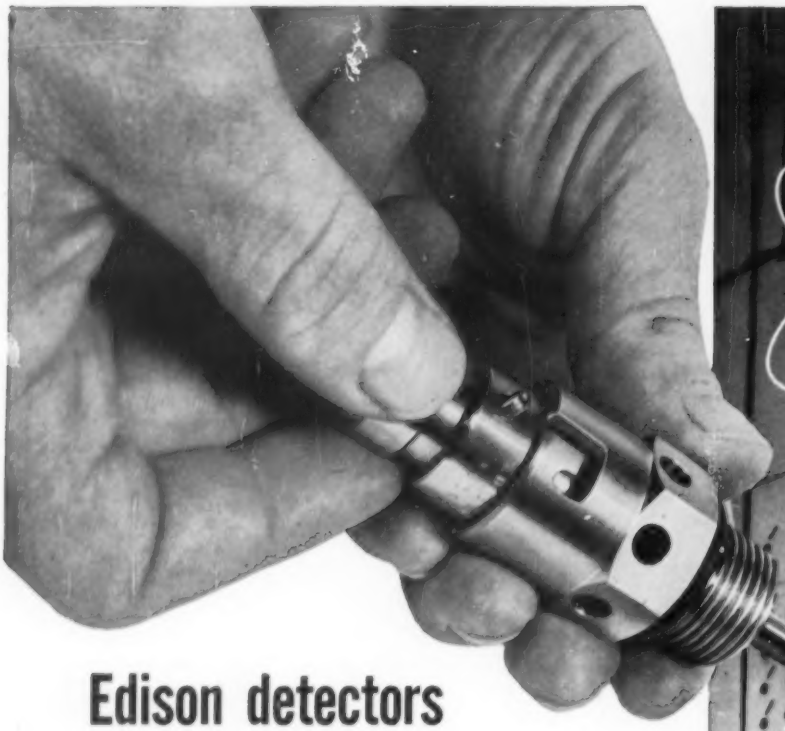
This view of the turbine room shows in the foreground the No. 2 12,650-kw Elliott turbine-generator unit. Underneath it may be seen the Elliott 11,000-sq-ft surface condenser serving this turbine. Ejectors are behind the generator. In the left background is the 7500-kw Elliott turbine-generator unit installed in 1950.





The photograph above shows two air compressors driven by Elliott C-W 75-hp, 1765-rpm motors. In the foreground, the fuel oil booster pump is driven by a 15-hp, 740-rpm motor. Condenser is seen in the background.

The Elliott 128,010 lb-per-hr deaerating feedwater heater consists of a vertical heater mounted on a horizontal storage tank. It is located at an elevation near similar No. 1 unit.



Edison detectors give speedy warning of overheat in atomic pile

Self-monitor design assures fail safe operation

New Edison Resistance Temperature Detectors are especially developed to meet the exacting demands of the atomic power industry. These detectors are now helping forestall costly fuel cell damage by providing near-instantaneous detection of a rise in temperature in light water moderators.

Super reliable and simple in design, Edison detectors eliminate complex electronic components. Some are rated at 0.8 seconds maximum response time and the high temperature types give an accuracy of $\pm 1.0\%$ at 750°C. Radiation- and corrosion-resistant, Edison detectors have quick disconnect features for reduction of installation and maintenance time.

Write for Bulletins 3016 and 3036 for information on types of Resistance Temperature Detectors and remote temperature monitoring systems for every purpose.

Thomas A Edison

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

Thomas A. Edison

INCORPORATED

INSTRUMENT DIVISION • 17 LAKESIDE AVENUE • WEST ORANGE, NEW JERSEY

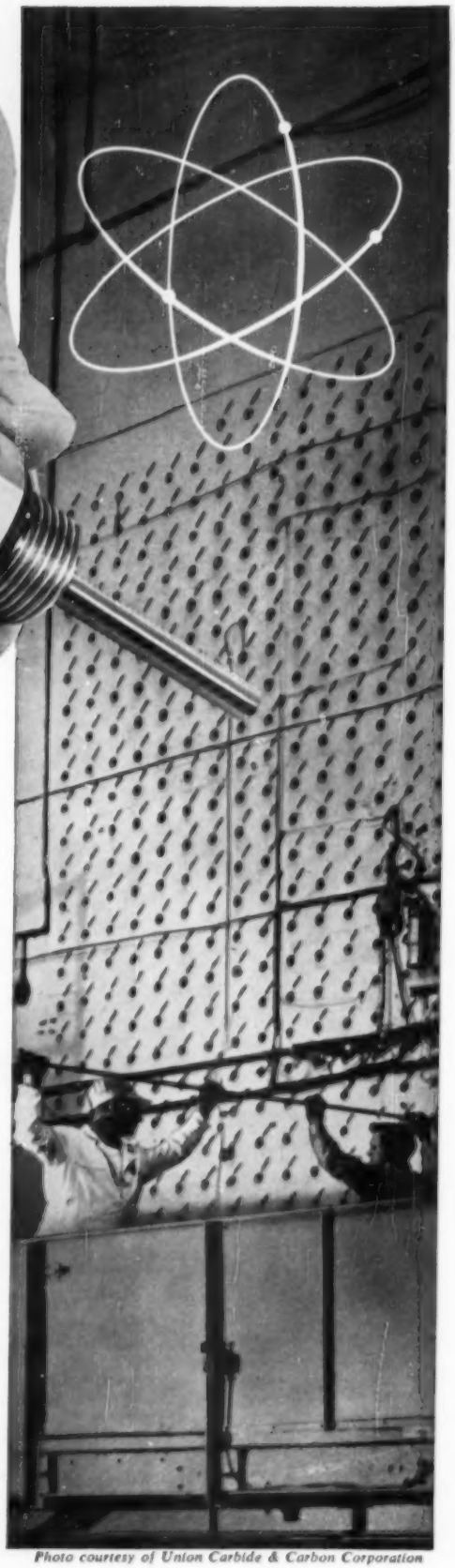


Photo courtesy of Union Carbide & Carbon Corporation

For more data circle 502 on Post Card

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NBP BPA

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

FINAL program for the Solar Furnace Symposium, January 21–22, at Hotel Westward Ho, Phoenix, Arizona, has been announced. Attendance of over 300 scientists and engineers is anticipated. Co-sponsors with the Association for Applied Solar Energy are Stanford Research Institute, Arizona State College at Tempe, and the University of Arizona.

According to AFASE president Jan Oostermeyer, the symposium has been organized to bring American industry and governmental agencies the latest information on the role of solar furnaces in the study of materials at very high temperatures. One of the highlights of the program is a visit to the solar furnace at Arizona State College. This furnace has reached temperatures of over 5400 F and is being used in conducting experiments in heat wave transmission through ceramics.

The program consists of 3 technical sessions, 2 luncheons and an evening session designed especially for the general public interest. Dr. C. C. Furnas, Assistant Secretary of Defense for Research and Development, will address the public session on Monday evening. Dr. Richard Kassander of the Institute of Atmospheric Physics, University of Arizona, will speak at the Monday luncheon. He will discuss Fuel for Solar Furnaces. Many other leading scientists and engineers will address the meeting.

Symposium arrangements are being made through the Secretary of the AFASE, John I. Yellott, 3424 N. Central Ave, Phoenix, Arizona.

GENERAL ELECTRIC CO'S Atomic Power Equipment Department, which centralizes all company efforts in design, development, manufacturing and marketing of peacetime atomic equipment, has announced completion of its move from Schenectady, N. Y. to San Jose, Calif. Department headquarters are now established in a newly constructed building at 2151 South First Street, San Jose. The department also will occupy additional office and manufacturing facilities eventually to be vacated here by the company's Medium Induction Motor Department.

Construction of the company's Vallecitos Atomic Laboratory, a department component, is proceeding rapidly at nearby Pleasanton, Calif.

Already announced Vallecitos facilities include a radioactive materials laboratory, a critical experiment laboratory with associated accessories, including a nuclear test reactor and a developmental boiling water power reactor.

This power reactor will supply steam to a 5,000-kw turbine generator, which will be installed and operated by the Pacific Gas and Electric Co. Electric power from this installation will be fed into the P. G. & E. power system.

Among products the department will produce are power reactors, research and test reactors, fuel elements, reactor sub-systems, auxiliaries, and component equipment.

AMERICAN INDUSTRY is beginning to put some steam pressure into the effort to meet the well-recognized need for more highly trained technical personnel. Every day, specific instances of some such effort by one particular industry or group comes to our attention. We've already referred to the activity being carried out by the coöperation of Lake Forest College and Fansteel Corp.

Now we learn that Public Service Electric and Gas Co of New Jersey has begun a 30-week power systems engineering course for its engineers. It is patterned after a similar course offered to a selected number of utility engineers by General Electric Co.

Another effort along this line is the Edison Foundation Institute's Meetings, of which the Seventh Institute held in November was devoted to Strengthening Science Education for Youth and Industry.

In this field, the work of the various professional engineering socie-

We Are Looking For Editors

POWER ENGINEERING is expanding and will have openings for graduate engineers in the mechanical or electrical field with a good solid background of operating, design, and construction experience. If you like to travel, meet people, learn of new developments, investigate new ideas, and if you have imagination, ingenuity and tact, together with a reasonable command of English, you will find this interesting work. There are several openings on the editorial staff, but the immediate one has the following specifications:

A graduate engineer from 45 to 50 years of age, who has gone through a cadet or student engineer's course with one of the public utilities, spent a number of years in the operating department, two or three years in the power sales department, and a number of years as power engineer with industrial companies, and who holds a professional engineer's license.

Another opening could be filled by a graduate engineer about 30 years old, with good grounding in engineering fundamentals, and particularly in heat power engineering. Subsequent to graduation, he should have had several years of work in a utility or industrial power plant, or in an industry having diversified steam and electrical problems.

If you meet all or many of the above specifications and are interested in the above jobs, send complete details of your education and experience to Editor of POWER ENGINEERING, 110 So. Dearborn St., Chicago, Ill. Mark your letter *personal* or *confidential*.

● PHILIP SPORN Plant, in the heart of the rapidly expanding Ohio River Valley, has been selected as the site for the 2nd of two 450,000-kw electric power generating units — largest in the world, it was announced recently.

The Sporn Plant is on the American Gas & Electric System at Graham Station, W. Va., and at present has a generating capacity of 600,000 kw. It is jointly owned and operated by Appalachian Electric Power Co and Ohio Power Co, AGE operating subsidiaries.

Like its AGE System sister unit, which is being built by Indiana & Michigan Electric Co on the Wabash River in Sullivan County, Ind., the new Sporn unit will be 73 per cent larger than any power-producing unit operating today.

Decision was based on 3 important factors: the need for still greater generating facilities in the dynamic Ohio Valley, the fact that the plant is situated near the geographical and load centers of the AGE System, and the plant's proximity to abundant, low-cost coal reserves.

With a capacity equivalent to over 600,000 hp, the unit will utilize close to 3,000,000 lb of steam per hr at the above-critical pressure of 3,500 psi and it will consume 1,300,000 tons of coal yearly.

● **CHARLES E. OAKES, president of Pennsylvania Power & Light Co, has announced the appointment of W. S. Brokenshire, assistant chief engineer of the company, as vice president, engineering. Mr. Brokenshire took his new post November 1 when he succeeded George M. Keenan who retired at that time in line with the utility's retirement program.**

Mr. Keenan will enter the service of a New York consulting firm which is advising the government of Greece on the financing, management, engineering and operation of electric power systems.

● TASTE of drinking water, particles in the air much finer than those that a smoker inhales from tobacco, impurities in iron totalling less than 0.04 per cent! These minutiae are parts of projects which take more than half of the funds spent coöperatively by iron and steel companies, through American Iron and Steel Institute, for research.

Studies on the taste and odor of drinking water are part of the industry's long-standing program to keep clean the streams and rivers where its plants are located. Research sponsored at an independent laboratory has shown that most tastes and odors have their origin in natural decay of vegetation and in algal blooms. Scientific detective work has pointed to fermenting oak leaves as a prime offender in affecting the taste and odor of water.

The iron and steel industry has had success in developing devices to keep dust from escaping to the atmosphere. At some plants, blast furnace gases released to the atmosphere are cleaner than the surrounding air.

Iron that is 99.95971 per cent pure is now being made for experimental purposes, although 14 other elements are contained in it.

ties, the Engineers Joint Council, the American Society for Engineering Education, the National Science Foundation, and other organizations too numerous to mention, is already beginning to take effect. As somebody pointed out recently, the shortage is a natural one caused by our tremendous expansion. Furthermore, it need not be a cause for despair but merely an indication that something needs to be done. Already the various procedures carried out to encourage high school students to enter science and engineering are beginning to bear fruit in increased enrollments in various engineering schools.

POWER ENGINEERING Reprints Available

CIGRE Meeting in Paris Reports World Developments in Electric Power Systems, by R. H. Morris and A. W. Kramer, 12 pages, August 1956 (Free)

Fifth World Power Conference, Vienna 1956, by R. H. Morris and A. W. Kramer, 12 pages, September 1956 (Free)

The Coal Storage Manual—24-page reprint from March 1956 issue—first 2 copies free; 12 copies, $10; 13 to 100 copies, 80 cents each; over 100 copies, special price will be quoted

So You're Going to Overhaul Your Turbine Generator—48-page reprint of series of articles on U. S. Steel Company's Turbine Overhaul, April 1955 to August 1956. First single copy free; additional reprints up to 10 copies, $1 each; 11 to 100 copies, 80 cents each; over 100 copies, special price will be quoted

DE LAVAL OPPELLER PUMPS

last longer... cut maintenance costs

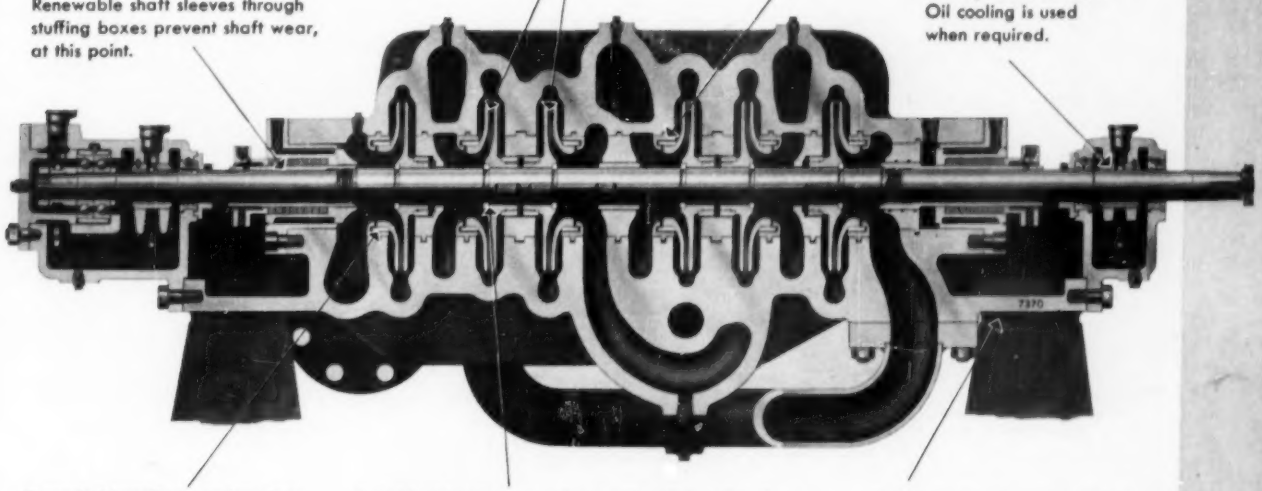
Stages are arranged to reduce differential pressures between stages. This insures permanent sealing at the casing-joint and at interstage diaphragms.

Pairs of back-to-back impellers balance axial thrust. One-purpose thrust bearing carries no radial load, maintains axial alignment.

Labyrinth wearing rings permit safe clearances and reduce wear.

All bearings are ring-oiled, sealed against contamination by water or dust. Oil cooling is used when required.

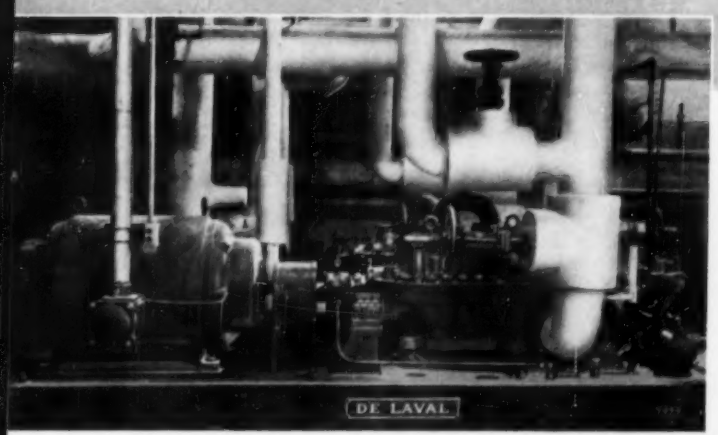
Renewable shaft sleeves through stuffing boxes prevent shaft wear, at this point.



Threaded impeller wearing rings make replacement easy without heating or damage to impellers.

Individual impeller mountings, with split locating rings, make interstage shaft sleeves unnecessary. Impellers can't shift with shaft expansion and contraction.

Casing support insures coupling alignment at any operating temperature.



Here are two De Laval 6-stage Oppeller Pumps used for boiler feed service in an industrial installation.

The design features above show clearly why De Laval Oppeller Pumps stay on the line longer and cost less to maintain. These pumps are used for boiler feed, hydraulic systems, descaling spray, mine dewatering, refinery oil pumping and similar services.

De Laval Oppeller Pumps are available in sizes from 2 to 4 inches and 2 to 8 stages; capacities to 1000 gpm, pressures to 1200 psig and temperatures to 350F.

DE LAVAL *Oppeller Pumps*

DE LAVAL STEAM TURBINE COMPANY

816 Nottingham Way, Trenton 2, New Jersey

PL284

WHAT THEY TELL US

▶ **IS IT ALWAYS** safe to have one-man operation of a boiler plant or power plant? Here's what Lewis C. Van Huben, chief engineer at Rockland State Hospital, Orangeburg, N. Y., has to say about it:

> I recently read your article, Estimating the New Steam Plant by Robert Gilkison (August issue) with a great deal of interest. While I hesitate to criticize mechanical engineers and consultants, my 35 years of experience in the operation of power plants (15 in supervisory capacities), compels me to take exception to one statement. It may start an argument; however, I would welcome a concensus of opinion.
>
> On page 74, 1st column, the article says, "It was contemplated that 1 man per shift would be ample . . ." This seems to me to be very unwise planning.
>
> In any power plant, the boiler room is of utmost importance because it contains the greatest potential hazards. There could be low or high water, make-up trouble, mechanical failures of stokers or auxiliaries; also, burst or ruptured boiler tubes from causes other than water losses sometimes happen. The one man could be injured, or become suddenly ill. Operational troubles requiring immediate help could arise.
>
> In ordinary operation, a large clinker formation (*they do occur!*) could interrupt steam production for a considerable period. Removal of such formations usually requires a lot of time and manual effort. At such times stokers are stopped or slowed up, furnace doors are kept open, and combustion is at a standstill. I have seen firemen laboring with these nuisances until they were almost knocked out physically.
>
> It is my contention that there should never be less than 2 men per shift, even though one may be only a coal passer, helper or common laborer. I would consider the cost of the extra man a calculated economy, and there is always work he could be doing. What do others think?
>
> Incidentally, I enjoy your magazine very much.

"Nothing can be made foolproof," Author Robert Gilkison replies to Mr. Van Huben's comments, and continues:

> . . . . Even though accidents and failures have happened, automatic controls of the components of steam generation have advanced considerably, and unbelievable performance records are being established.
>
> It would seem to me, that in planning a properly-manned plant with shift operators, first the use of the services to be produced should be understood and considered. Second, it should be determined if the necessary investment will be made for equipment to permit a minimum of operating labor.
>
> Your position as chief engineer of a plant furnishing services for a hospital, whose services in turn deal with human beings, makes it necessary that no risks be taken that might jeopardize round-the-clock service.
>
> I should like to tell you about one instance where a fireman fell asleep on his shift in the boiler room of a hospital while 2 men and the maintenance man were on duty. The plant had only 2 boilers; one was on the line, and the 2nd was down for repairs. The feedwater supply failed, and $3000 worth of tubes were burned. The boiler was out of operation for 3 days, and the hospital was without steam for 24 hours. The 2nd man on the shift did not prevent this shutdown.
>
> So while there may be 2 men on each shift, the human element of possible hazard remains, and could cause considerable damage.
>
> In public utility plants, considerable investment in equipment must be made before one operator's salary can be eliminated from operating costs. Management, however, makes careful and lengthy studies to determine whether or not equipment of the power cycle can be altered in order to eliminate an operator.
>
> I agree that it would be interesting to know what others think. Please note, however, that in my article I stated that the subject plant had been in almost continuous service since November 1953, without involuntary shutdown. Don't you think that is a fairly good record of service?

▶ **WHO HAS** a job for this man?

> I took your address from POWER ENGINEERING, of which I have been a regular reader.
>
> A few days ago I fled with my wife and two sons (aged 11 and 16 years) from Budapest, and at the moment we are waiting here in Vienna for our visas to the U. S.
>
> I am now 49 years old and received my diploma for Mechanical Engineering in 1929. Up to 1948 I worked as plant-and-service engineer, later as chief engineer and purchasing agent in a textile bleaching and dyeing factory in Budapest, where I held a responsible position in the power plant and the workshop for the maintenance of machines.
>
> In 1948 I became vice chief engineer of the State Projecting Office where all the power plants were planned that were built for the industry in Hungary. These included high-pressure plants (1900 psi, 950 F).
>
> My wife was a draftswoman for 5 years in the Hungarian Office for Power Station Design. We both speak and write German and French fluently, and English a little.
>
> We would be most grateful if you could find us both suitable jobs. It would also be much easier for us, if we could know in advance where we might work. We should like, if possible, to work in a consulting engineering organization where they deal with planning of the supply of steam and electric power.
>
> Thank you very much for any help you can give us.

The above letter comes from Geno Klopfer, Wien LX, Garmsongasse 7, Pension Austria. Sounds interesting. If you can do anything to help, write him direct at that address.

▶ **MEET THE ENGINEER,** on the air waves for almost 4 years, is now a 15-minute program over Radio Station WFLN-FM every other Saturday evening from 6:45 to 7:00.

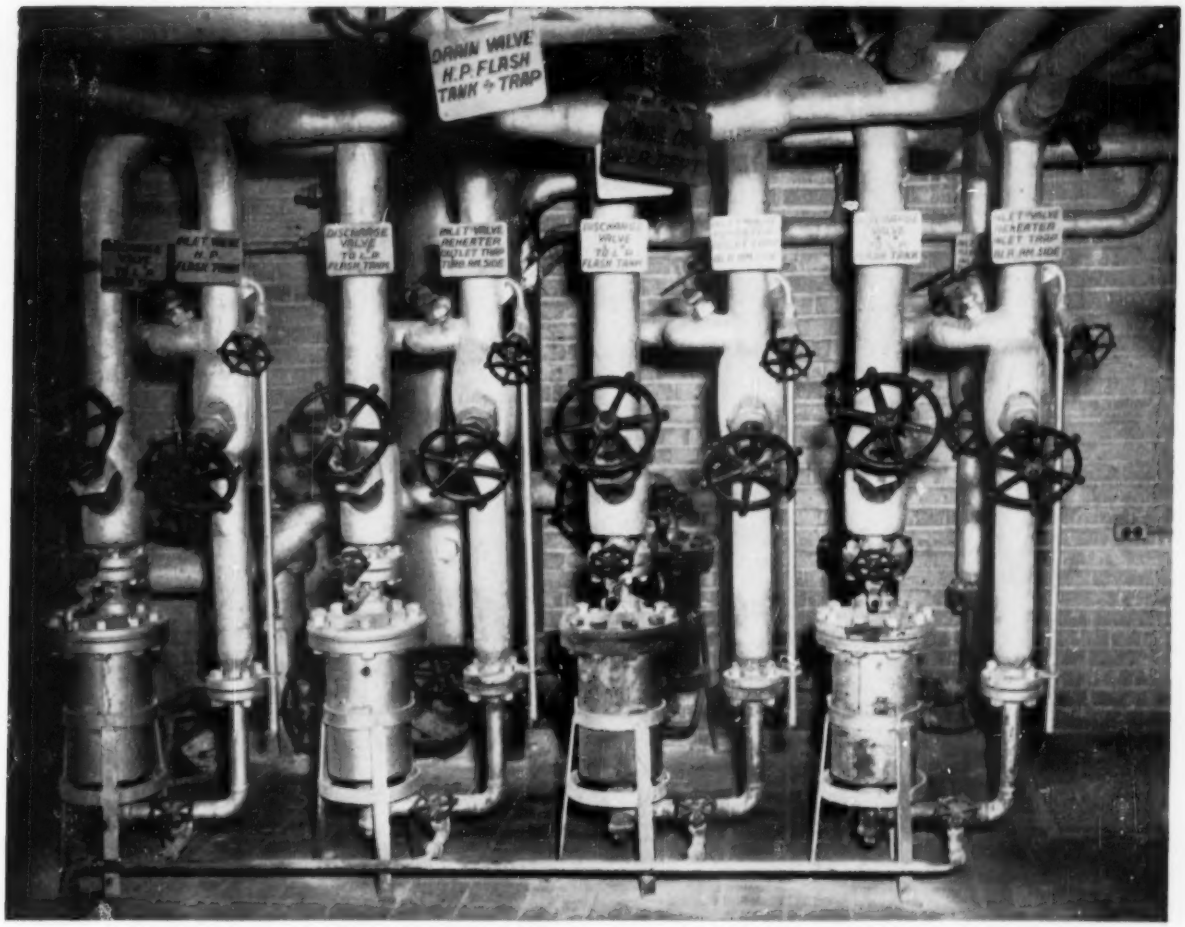
Editor Andy Kramer, who has been a guest speaker on 4 previous occasions, will return to the program February 9 to discuss his recent trip through Europe and Russia. He will give Eye-Witness Accounts of European Development Progress, and on February 23 he will talk about Russian Development Progress.

Mr. Kramer will be heard again, March 9, when the 50,000-Miles-Without-Refueling Run of the *Nautilus* will be discussed.

Correction Note: In the article entitled What You Should Know About Germanium Rectifiers by W. L. Overstreet, of General Electric Co, on page 112 of our December 1956 issue, an error was made in drawing the curves shown in Fig. 4.

These curves show the relationship between d-c volts output and operating hours for a test period of more than four years. The correct curves should have shown the germanium cell voltage remaining constant for the duration of the test, and the selenium cell voltage falling off with time. As presented, the germanium cell voltage falls with time, and this is wrong.

We will publish a corrected curve in our February issue. Our apologies to Mr. Overstreet and General Electric Co for this error.



"Panel" of Eleven says Traps are Best for draining Superheated Steam Lines

. . . AND THESE PLANTS AGREE

Typical Armstrong high pressure trap users:

Consumers Power Company—
Comstock, Erie, Essexville, Muskegon, Zeiwaukee, Michigan

Ohio Power Company, Philo, Ohio

Kansas City Power & Light—
Kansas City, Mo.

Georgia Power Company—
Yates, Macon, McManus, Georgia

United Illuminating Company—
New Haven, Conn.

Philadelphia Gas & Electric—
Philadelphia, Pa.

San Diego Gas & Electric—
San Diego, Calif.

Wisconsin Electric Power Company,
Milwaukee, Wisconsin

Northern States Power Company—
St. Paul, Granite Falls, Black Dog, Minn.

Cincinnati Gas & Electric Company,
Cincinnati, Ohio

One of the readers of a power plant publication recently asked, "which is the best device for removing condensate from lines carrying superheated steam . . ."

Eleven readers answerd this published question. *All* agreed, from experience, that steam traps are best.

Traps are automatic. Traps prevent steam loss. Traps take care of boiler carryover. Traps are available with sufficient capacity to take care of any condensate load. Traps don't "forget" to drain the lines.

Since 1929, Armstrong inverted bucket forged steel steam traps have kept pace with the trend to higher steam pressures. Today, they are widely recognized as essential safety devices in leading power plants throughout the world operating at pressures up to 2400 psig.

For safe, dependable drainage of superheated steam lines, get the facts about Armstrong traps. Call your local Armstrong Representative or write Armstrong Machine Works, 8101 Maple St., Three Rivers, Michigan.

ASK FOR REPRINT—

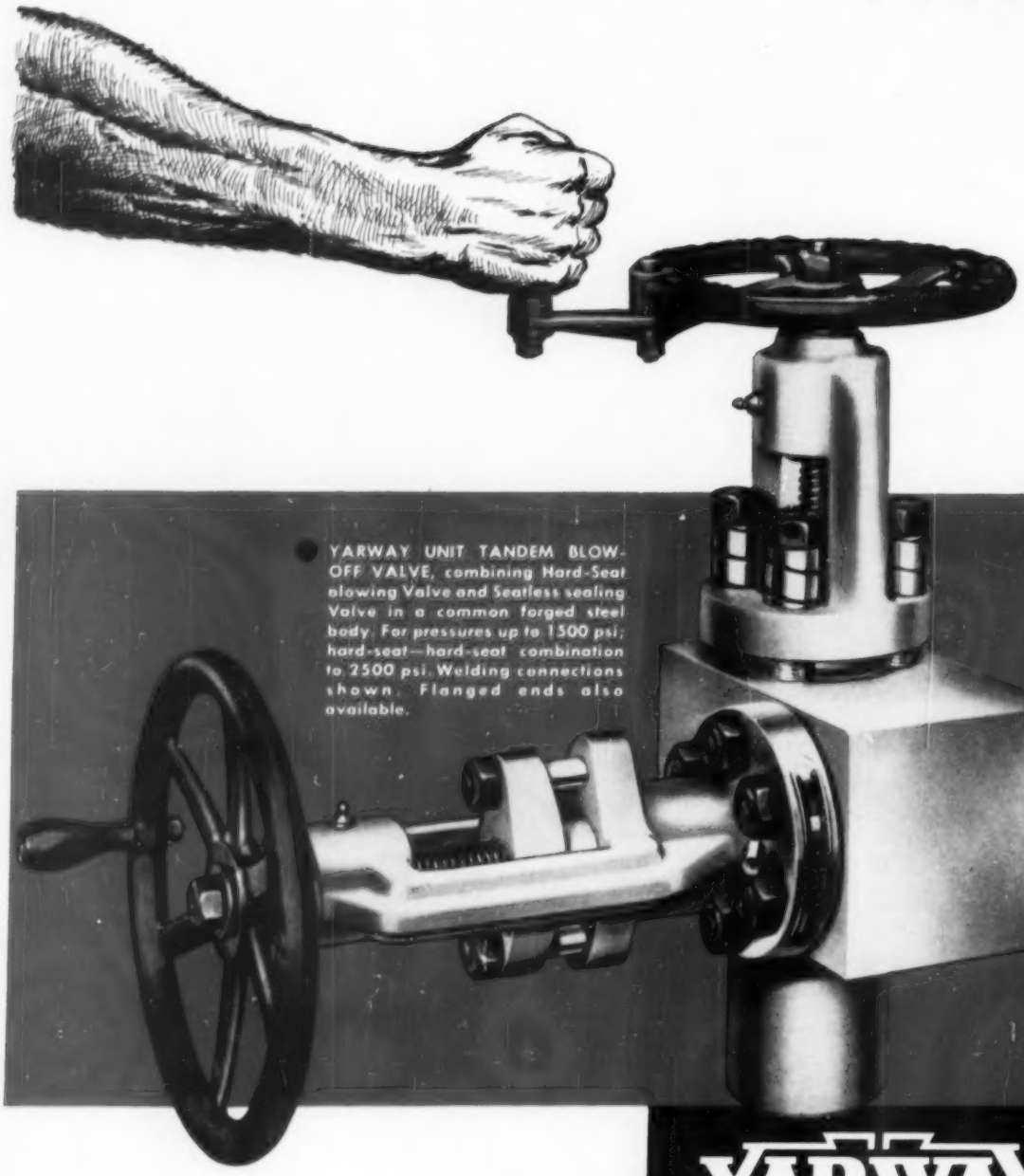
"Should We Trap Superheated Steam Lines"—tells the experience of trap users . . . answers your questions on high pressure trapping. Ask for Catalog J, too . . . complete data on Armstrong forged steel traps. Free on request—no obligation.

Application Engineered

ARMSTRONG STEAM TRAPS

For more data circle 504 on Post Card

rugged
... for



YARWAY UNIT TANDEM BLOW-OFF VALVE, combining Hard-Seat blowing Valve and Seatless sealing Valve in a common forged steel body. For pressures up to 1500 psi; hard-seat—hard-seat combination to 2500 psi. Welding connections shown. Flanged ends also available.

YARWAY

rugged blow-down service

YARWAY UNIT TANDEM BLOW-OFF VALVES

When boiler pressures are high you may not "blow-down" very often, but, man, when you do, you're glad those blow-off valves are rugged YARWAY Unit Tandems!

More than 80% of high pressure boiler plants are equipped with YARWAY *Blow-Off Valves,* and there's ample reason.

YARWAYS are strong, heavy-duty valves giving the important extra dependability needed for the severe combination of high pressures (hence high velocities), acid cleaning, and abrasion caused by precipitated solids.

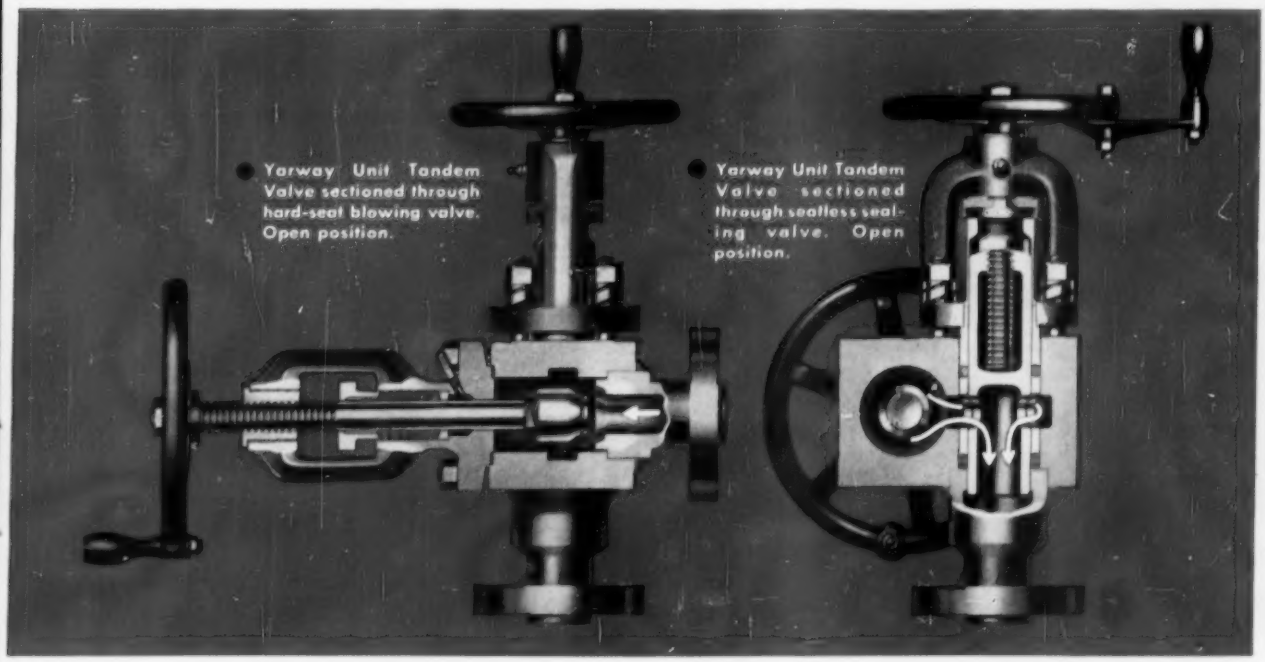
YARWAY Blow-Off Valves also are relied upon to keep boiler level within desirable limits during quick starts of high pressure boilers.

Specify YARWAYS—to protect *your* boilers. Write for Bulletin B-434.

YARNALL-WARING COMPANY

100 Mermaid Ave., Philadelphia 18, Pa.

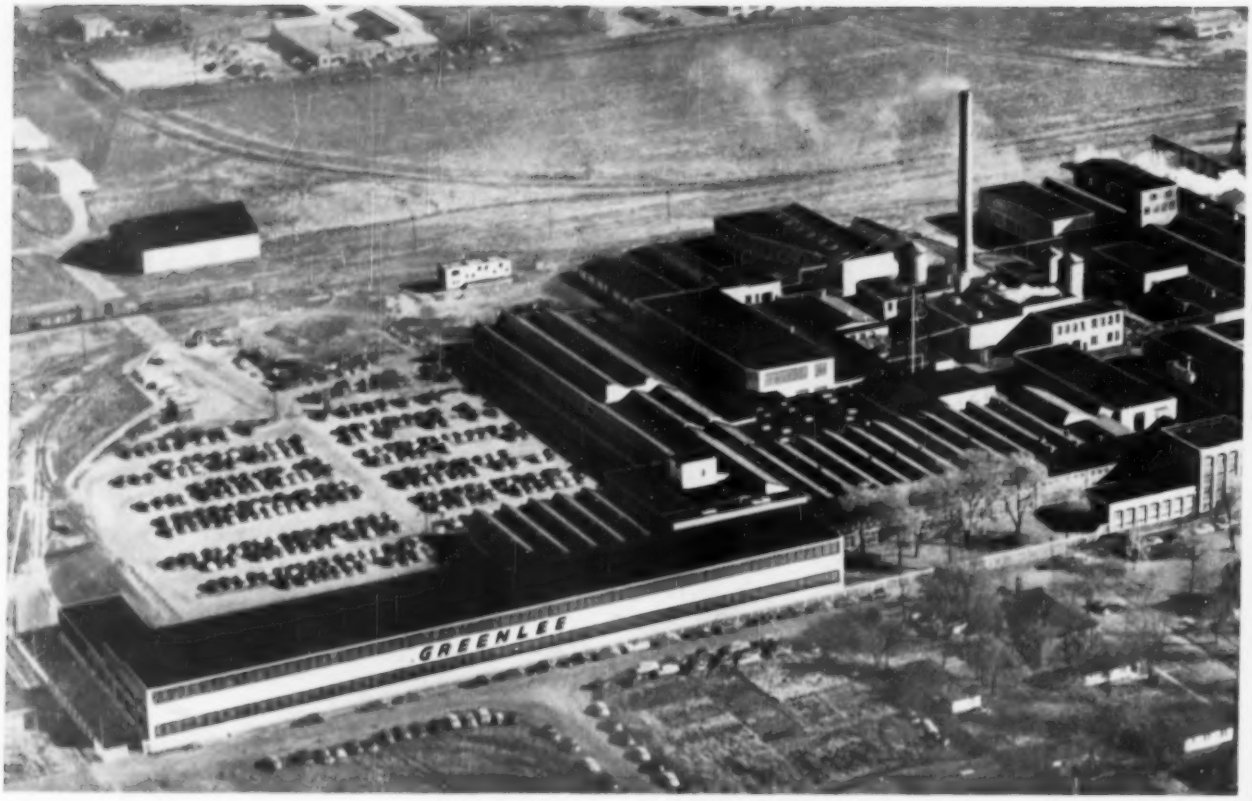
BRANCH OFFICES IN PRINCIPAL CITIES


Yarway Unit Tandem Valve sectioned through hard-seat blowing valve. Open position.
Yarway Unit Tandem Valve sectioned through seatless sealing valve. Open position.

— blow-off valves

For more data circle 505 on Post Card

GREENLEE BROS. & CO.



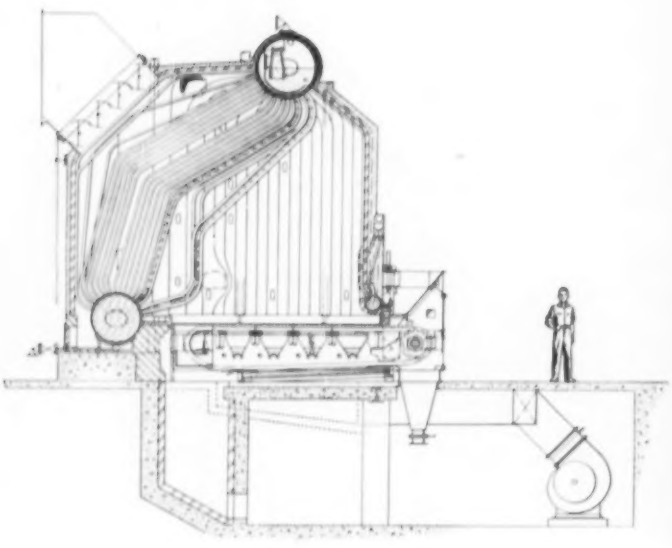
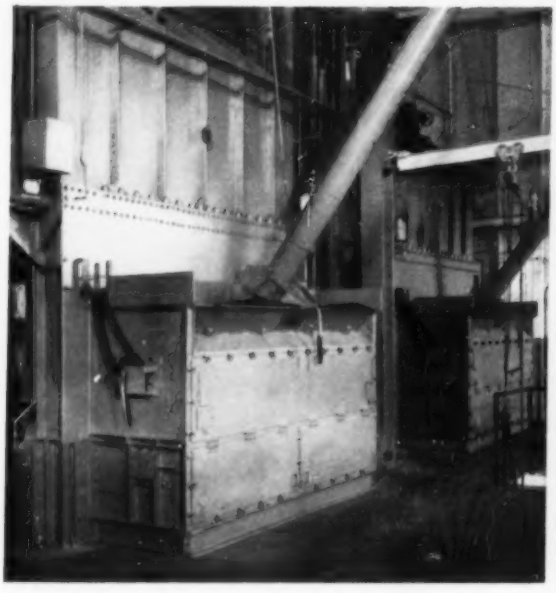


Diagram of B&W Integral-Furnace Boiler with Jet Ignition Stoker. Each unit generates 30,000 lbs of saturated steam per hour at 125 psig.



Two B&W Integral-Furnace Boilers at Greenlee, equipped with B&W Jet Ignition Stokers, burn a wide variety of Illinois bituminous coal.

CUT FUEL COSTS 14%

B&W Boilers with Jet Ignition Stokers assure savings despite increased fuel prices

As one of the country's leading manufacturers of machine tools, Greenlee Bros. & Co., Rockford, Illinois uses large amounts of steam for all year operation of air compressors and for plant heating. And to maintain profitable overall operation it is important that the steam supply be dependable—and steam generating costs kept to the minimum.

Since the installation of two B&W Integral-Furnace Boilers, Greenlee has enjoyed uninterrupted steam service from a dependable, efficient source. Equipped with modern B&W Jet Ignition Stokers, the B&W units have established an outstanding record of operating efficiency while burning a wide variety of Illinois bituminous coal.

At Greenlee, as at other industrial plants using steam, careful consideration of long term costs and proven reliability were important factors in the choice of B&W Integral-Furnace Boiler units.

If your steam production cost is important . . . if you are considering steam plant modernization or expansion for increased dependability and efficiency . . . it will pay you to investigate B&W's more than 90 years of boiler experience. Let us show you what it can do for you. For further information or assistance write to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-773-18

HERE'S WHY YOUR STEAM COSTS LESS With B&W Integral-Furnace Units

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

BOILER DIVISION

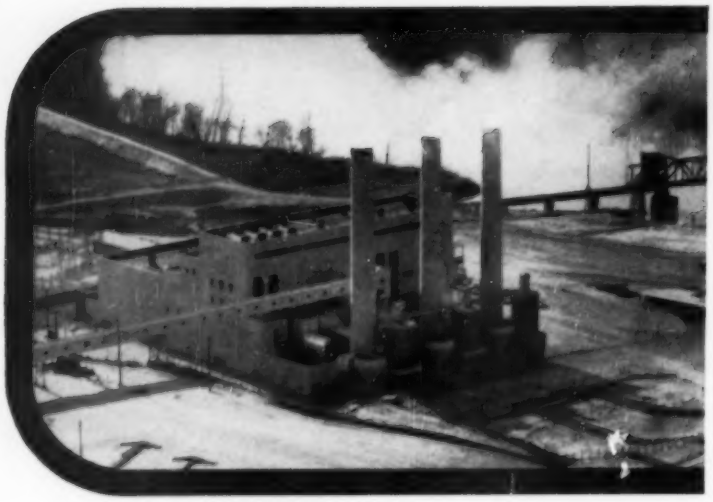
For more data circle 506 on Post Card

South Carolina Generating Company's

(Wholly-owned Subsidiary of South Carolina Electric & Gas Co.)

URQUHART STATION

UNIT No. 3



where . . . **REPUBLIC** *Automatic*

COMBUSTION CONTROLS *Anticipate* **FUEL-AIR-WATER REQUIREMENTS!**

BRIEFLY—this is how it works:

Controls Respond First to Load Changes

REPUBLIC "Electronic Master" combustion control first detects any change in steam flow and immediately transmits a signal proportional to that change to the combustion air, coal pulverizers and/or gas valve, and feedwater valve.

Curb Pressure-Water-Temperature Changes

Corrective settings of each of these controls starts *with* the steam flow change and follows the change closely; this keeps steam, fuel, air, water and (of course) flue gas flows in the closest possible balance, minimizing fluctuations of header pressure, drum water level, and superheater outlet temperature.

Pressure Controls Follow Up

Any slight change of header pressure or drum level that *does* occur is immediately detected and fed to the proper control as a modulating signal that restores complete balance . . . quickly.

Combined Fuels—Stable Operation

This combination of flow-initiated and follow-up adjustments, with electronic control and pneumatic drive units, means top-notch stability, accuracy, sensitivity and reliability for Urquhart Station's Unit No. 3, even while burning combined fuels!

REPUBLIC FLOW METERS CO.

Urquhart No. 3's control room where automatic and remote-manual controls are centralized.

URQUHART STATION, UNIT No. 3
STEAM DATA:
Rated Capacity 700,000 LB/HR ——— 1825 PSI
SUPERHEAT 1010 F ——— REHEAT 1010 F
FUEL: PULVERIZED COAL AND/OR GAS
COMBUSTION CONTROL:
REPUBLIC Automatic ELECTRONIC

Planned expansion of power for the great Southeastern United States is typified by the latest addition to Urquhart Station of the South Carolina Generating Co. Planned by Gilbert Associates, Unit No. 3 is modern today and will be modern tomorrow —*and will be considered "modern" by performance as well as appearance standards.*

REPUBLIC's "Electronic Master" combustion control is a logical partner in such advanced thinking. The quick, long arm of electronic control plus reliable, powerful actuation by pneumatics gives Urquhart No. 3 the reflexes it needs to meet any operating crisis and hold single—or combined—fuel consumption low. For greatest speed of control, REPUBLIC has provided a load-responsive system that regulates all combustion factors *before* pressure drops or jumps occur. Any pressure fluctuations following this advance adjustment are very limited and are promptly compensated by a pressure control system that modulates the fuel and air control signals.

REPUBLIC's three element feedwater regulator adjusts feedwater flow in proportion to steam flow, and follows up this action with a correction for drum level. Total level fluctuations are thereby held to a strict minimum.

Remote manual operation of any or all control units is possible at any time. The operator need only throw the transfer switch on his panel and take over; indicators at the operating station show electronic loadings to the regulators and positioners, and show the rate of response and position. All electronic amplifiers have built-in surplus capacity for extra life and special design features for quick maintenance when needed.

This comprehensive treatment of control problems is typical of REPUBLIC engineering. Equally thorough follow-up and servicing make REPUBLIC a helpful partner in new or modernized power operations—of any size.

Need Help With "Early Stage" Planning? If you are planning ahead for new conventional or "unconventional" facilities, remember that REPUBLIC, too, is planning ahead. For help in projecting your new facilities in terms of new control, metering and recording equipment—and the latest in top quality valves—contact REPUBLIC's Engineering Department as soon as this help can be beneficial.

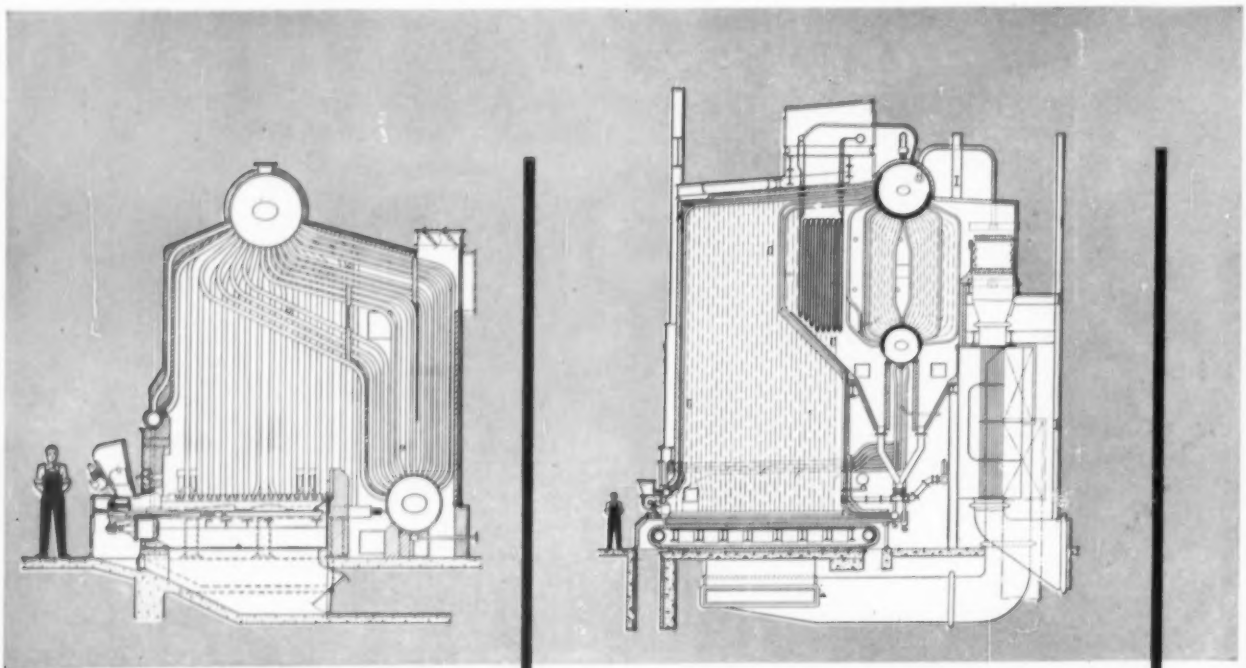
2240 Diversey Pkwy., Chicago 47, Illinois

For more data circle 507 on Post Card

MODERN STOKER-FIRED BOILERS

Despite the relatively wide extent to which oil – and gas – have come into use for firing industrial boilers, the fact remains that coal continues to be the most economical fuel available in many areas.

Moreover many potential coal users are unaware of the tremendous improvements that have been made in recent years in the design and general effectiveness of mechanical stokers. Here at Combustion virtually the entire stoker line has had extensive design changes, all directed at improved performance. But overall performance is tied in inescapably with boiler performance. At Combustion you have the important advantage of dealing with a leading boiler manufacturer that also offers the most complete line of stokers available anywhere. You are assured, therefore, of a completely coordinated design comprising



This C-E Vertical-Unit Boiler, Type VU-10 fired by a C-E Underfeed Stoker, Type E is for a dairy. Capacity is 30,000 lb steam per hr at 150 psig. VU-10 Boilers are available for capacities from 10,000 to 60,000 lb of steam per hr. They are often equipped with C-E Spreader Stokers, dump grate type.

One of two duplicate units for a chemical company comprising C-E Vertical-Unit Boilers, Type VU-40 fired by C-E Spreader Stokers, continuous discharge type. These are baffleless boilers designed for a capacity of 150,000 lb steam per hr at 900 psig and 808 F. Coal is Eastern Bituminous.

COMBUSTION

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

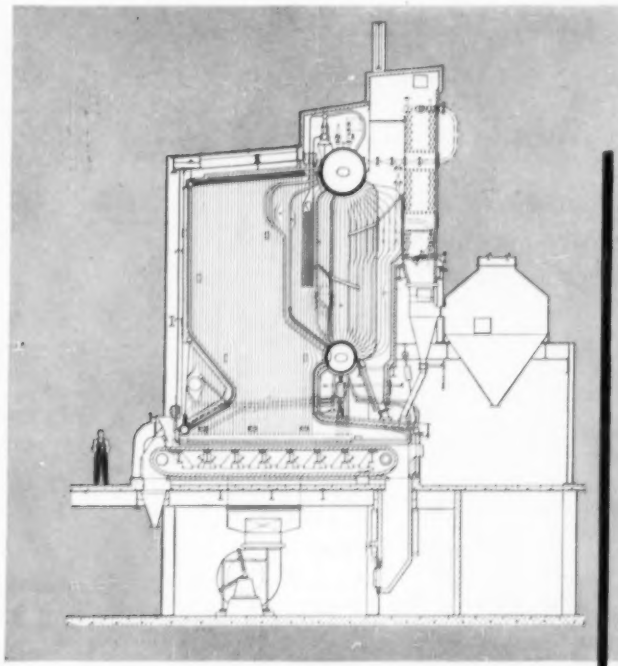
STEAM GENERATING UNITS; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS;

stoker, boiler, furnace and – if desired – heat recovery equipment and/or auxiliaries, all engineered specifically for your particular requirements.

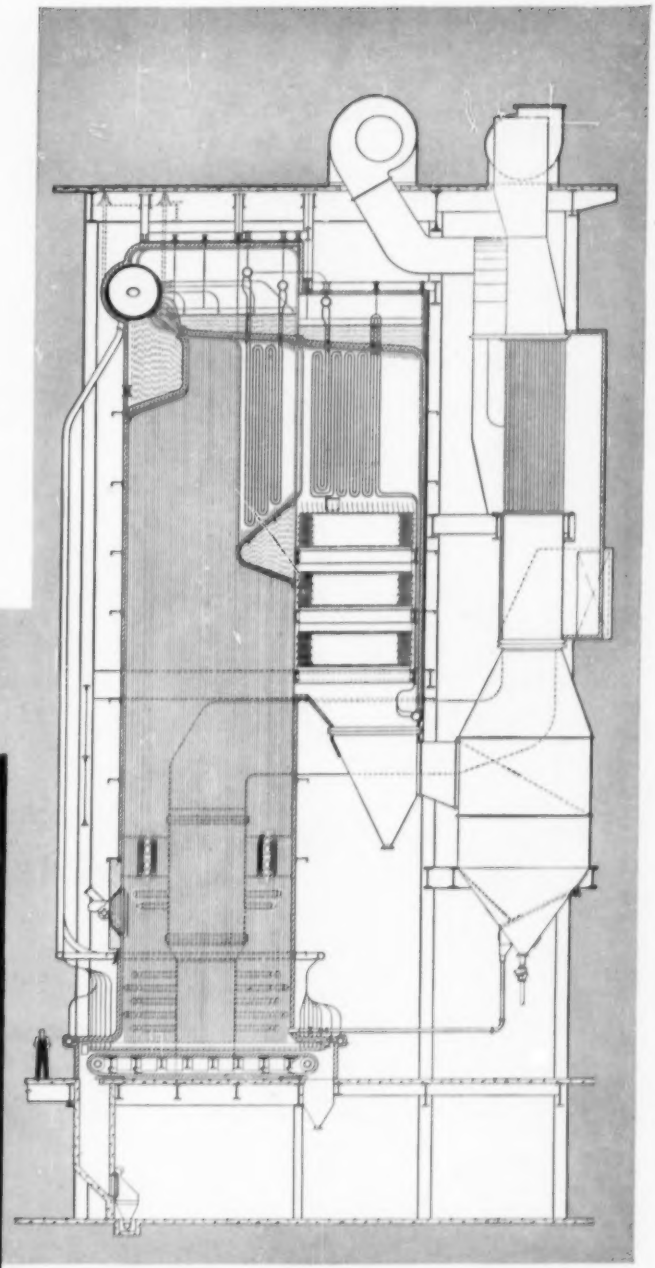
Displayed below are three – of the many – C-E stoker-fired boiler designs which, collectively, are suitable for any coal-firing conditions.

At the right is illustrated the latest – and largest – example of the C-E Bark-burning Unit, a design pioneered by Combustion and now widely used for burning bark, hogged-wood and other waste wood fuels.

So – when you are in the market for coal or other solid-fuel-burning units it will certainly be to your advantage to find out what Combustion Engineering has to offer. Our engineers will be glad to discuss your needs with you or your consultants. B-892



This C-E Unit is being installed for a soap company. It comprises a C-E Vertical-Unit Boiler, Type VU-50 fired by a C-E Traveling Grate Stoker. Coal used is Midwest Bituminous. This boiler is designed for a capacity of 100,000 lb steam per hr at 850 psig and 585 F. It is an outdoor type unit.



C-E Bark-Burning Unit for a paper company. This is a very large unit; capacity – 450,000 lb steam per hr, operating pressure – 1335 psig; total steam temperature – 958 F. It is designed to burn bark, natural gas, oil or any combination thereof. C-E Bark-Burning Boilers are in service for capacities as low as 20,000 lb of steam per hr.

ENGINEERING

CANADA: COMBUSTION ENGINEERING-SUPERHEATER LTD.

FLASH DRYING SYSTEMS; PRESSURE VESSELS; DOMESTIC WATER HEATERS; SOIL PIPE

For more data circle 508 on Post Card

It's in the Bag!

Fresh, Clean Ink for a Year of Trouble-free Recording

★ You won't have any messy, time-consuming re-inking of pens on the new Bailey Recorders. The entire system is white-glove clean—hermetically sealed, non-evaporating, non-corrosive. Gone is any chance of sludge or oxide formation. Gone are clogged pens, interrupted records, unsightly splashes.

The transparent plastic ink sacs are changed once a year—that's all. Capillary tubing carries fresh, clean ink to the pens continuously without any day-to-day attention.

This exclusive new inking system* is only one of the many time-saving, money-saving distinctive features of the new Bailey Recorder.

Ask for Product Specification E12-5.

P34-1

*Now available for the New Bailey Recorder only.

ONLY BAILEY OFFERS ALL THESE ADVANTAGES IN A SINGLE RECORDER

- Pre-calibrated plug-in receiver units
- Up to four pneumatic or electronic receivers —or two receivers and two integrators
- Any four variables on one chart—easily read and interpreted
- A full year's ink supply at one loading
- Faster ordering—from stock
- Minimum inventory of parts
- Minimum instrument investment for process cycle expansion or alteration

BAILEY METER COMPANY

1040 IVANHOE ROAD

CLEVELAND 10, OHIO

Controls for Power and Process

BAILEY METERS

Controls for

TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW · LEVEL
RATIO · DENSITY

For more data circle 509 on Post Card

A Small Plant Modernizes with DETROIT STOKER

PIERCE · ROBERTS · RUBBER CO·
TRENTON 6 · NEW JERSEY

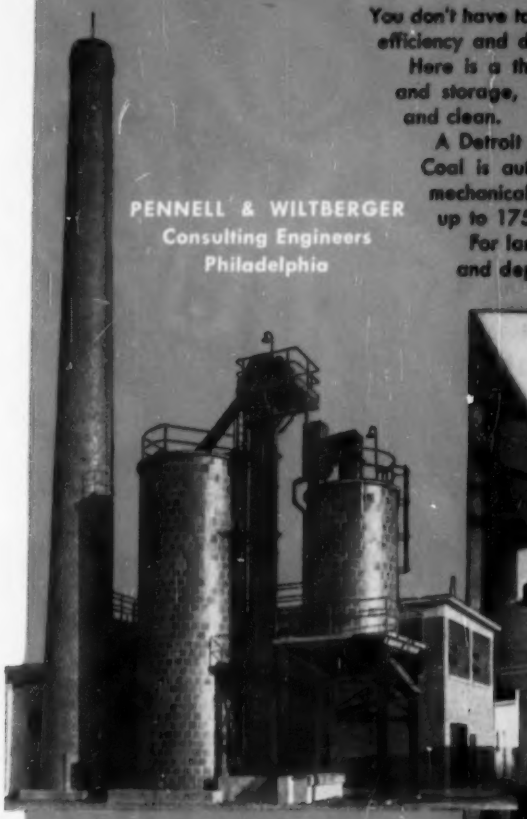
You don't have to have a giant plant to benefit from modernization, high efficiency and dependability of Detroit Stokers.

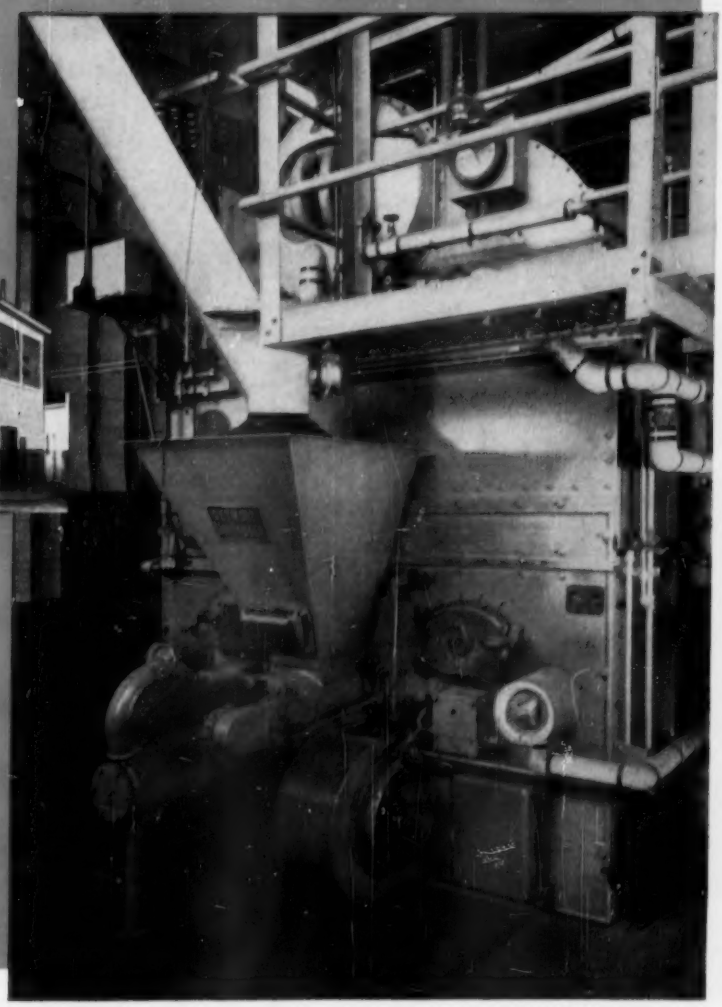
Here is a thoroughly up-to-date plant. Boiler, stoker, coal handling and storage, and ash handling are all modern, mechanized, efficient and clean.

A Detroit UniStoker fires a 200 horse power Keeler Type CP Boiler. Coal is automatically delivered to the stoker from a silo. Ashes are mechanically removed and stored. *No shoveling—no dirt.* Boiler operates up to 175% of normal rating at 125 p.s.i.

For large or small plants, Detroit Stokers provide modern, economical and dependable operation.

PENNELL & WILTBERGER
Consulting Engineers
Philadelphia





DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY
General Motors Building
Detroit 2, Michigan

Works at Monroe, Michigan
District Offices in Principal Cities

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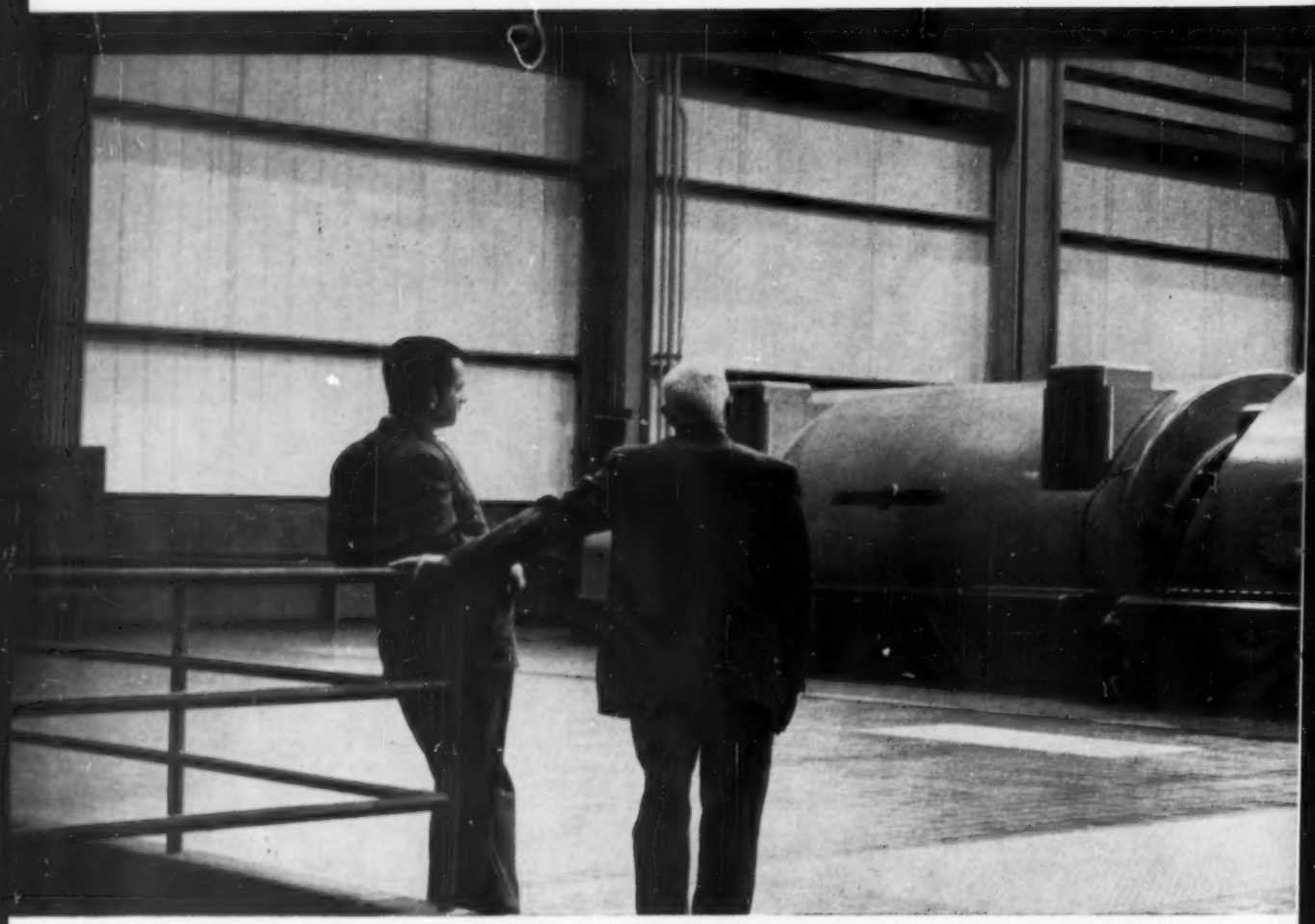
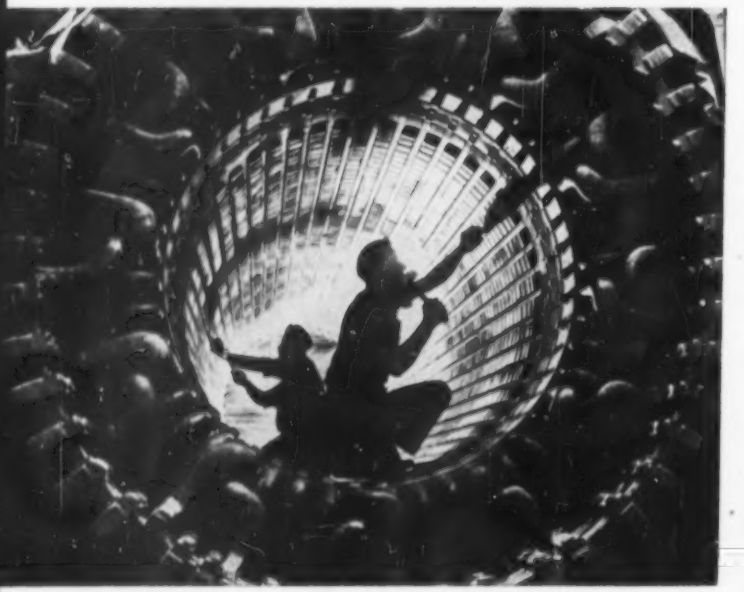


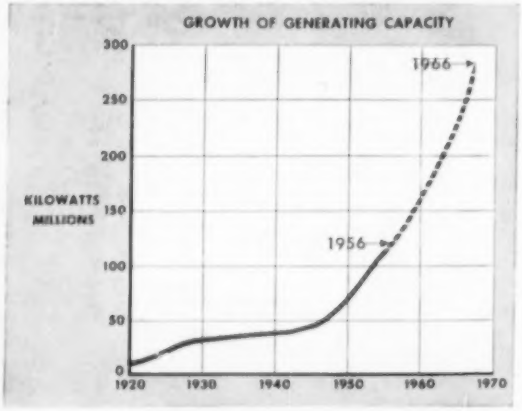
CAREFUL PLANNING FOR PRODUCTIVE MAINTENANCE INCLUDING STOCKING SPARE PARTS

How *Productive* Maintenance can help

TO MEET TOMORROW'S EXPANDING LOADS



THE FACILITIES of the world's finest turbine plant and 46 service shops located throughout the country back your General Electric unit.



G.E. works with electric utilities and consulting engineers in these vital turbine-generator areas:

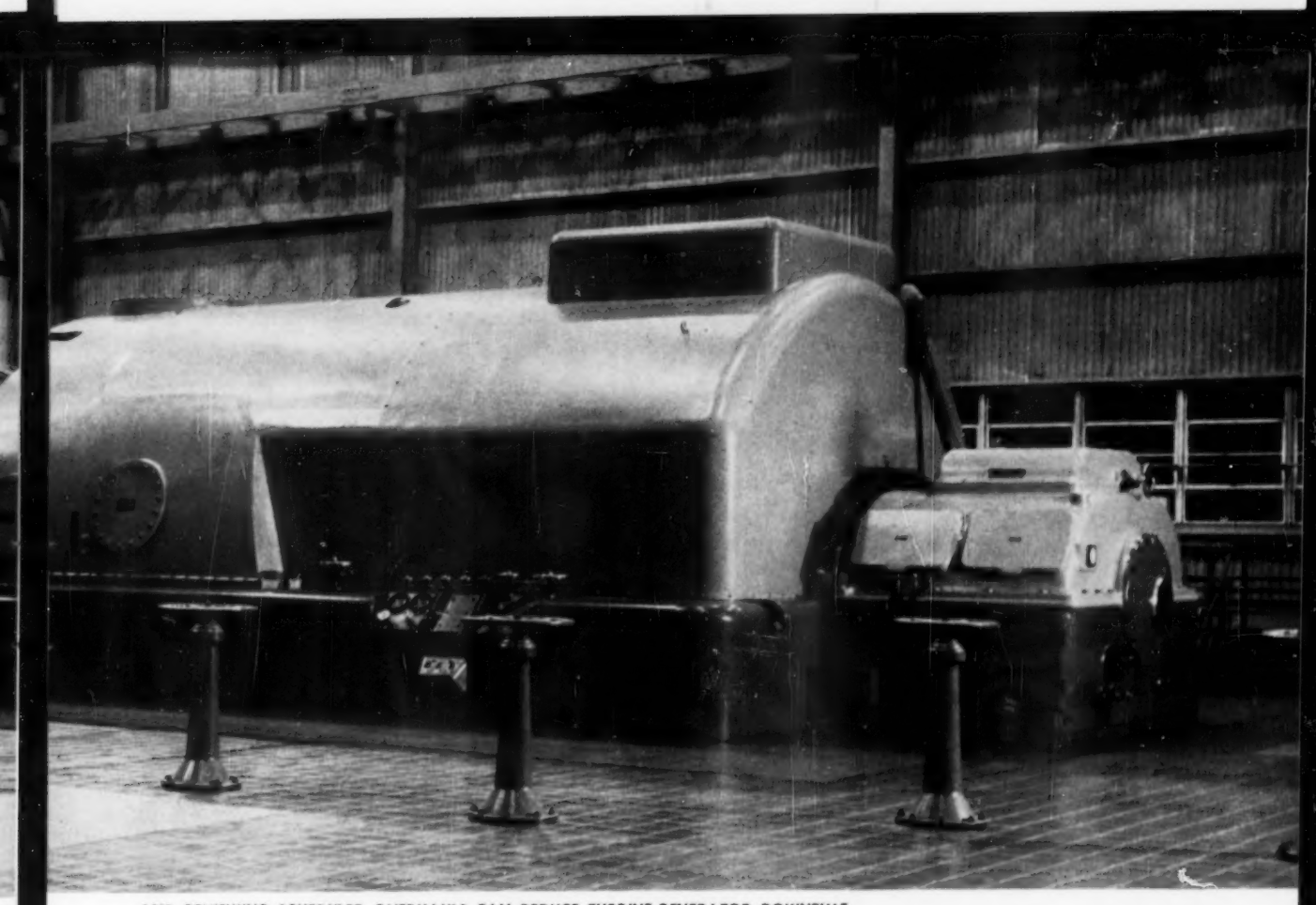
BASIC RESEARCH

APPLIED RESEARCH

PRODUCT DEVELOPMENT

TESTING

MAINTENANCE: PRODUCTIVE MAINTENANCE



AND REVIEWING SCHEDULED OVERHAULS CAN REDUCE TURBINE-GENERATOR DOWNTIME.

keep a turbine-generator on-the-line

General Electric's *Productive* Maintenance plan can help you reduce turbine-generator maintenance expenses. Here's how:

1) Maintaining a supply of General Electric spare parts can save valuable time. These parts fall into three categories:

a) Recommended parts such as thrust rings, springs for packing seals, brushes and brush holders, gaskets for control mechanisms, studs and nuts;

b) Optional spares such as rings for packing seals, bushings for control mechanisms, bearings and sealing rings for oil pumps; and

c) Major parts such as main bearings, rotors and stator bars.

G.E. can help you decide which to carry.

2) By using General Electric renewal parts along with Installation and Service Engineering supervision of inspection service, you benefit two ways. You take advantage of trained knowledge of the design and engineering characteristics of your unit and you obtain parts designed to meet original specifications. G.E. is familiar with your machine and at the time of planning overhauls can suggest possible modernization.

3) With the trend toward more uniform loads throughout the year—both summer and winter—scheduling outages is becoming a real problem. Your General Electric turbine-generator representative can help you plan your overhaul schedule. By applying G.E.'s *Productive* Maintenance plan, and where operating conditions warrant, it may be possible to extend the time between overhaul periods.

You can get service 24 hours a day, seven days a week if necessary on your G-E unit. The world's most modern turbine-generator manufacturing facilities, 46 G-E service shops and the G-E Installation and Service Engineering organization are ready to help you.

Planning *Productive* Maintenance is just one of many areas in which General Electric is co-operating with electric utilities to prepare for tomorrow's load growth today. For more information write Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York. 254-46

Progress Is Our Most Important Product

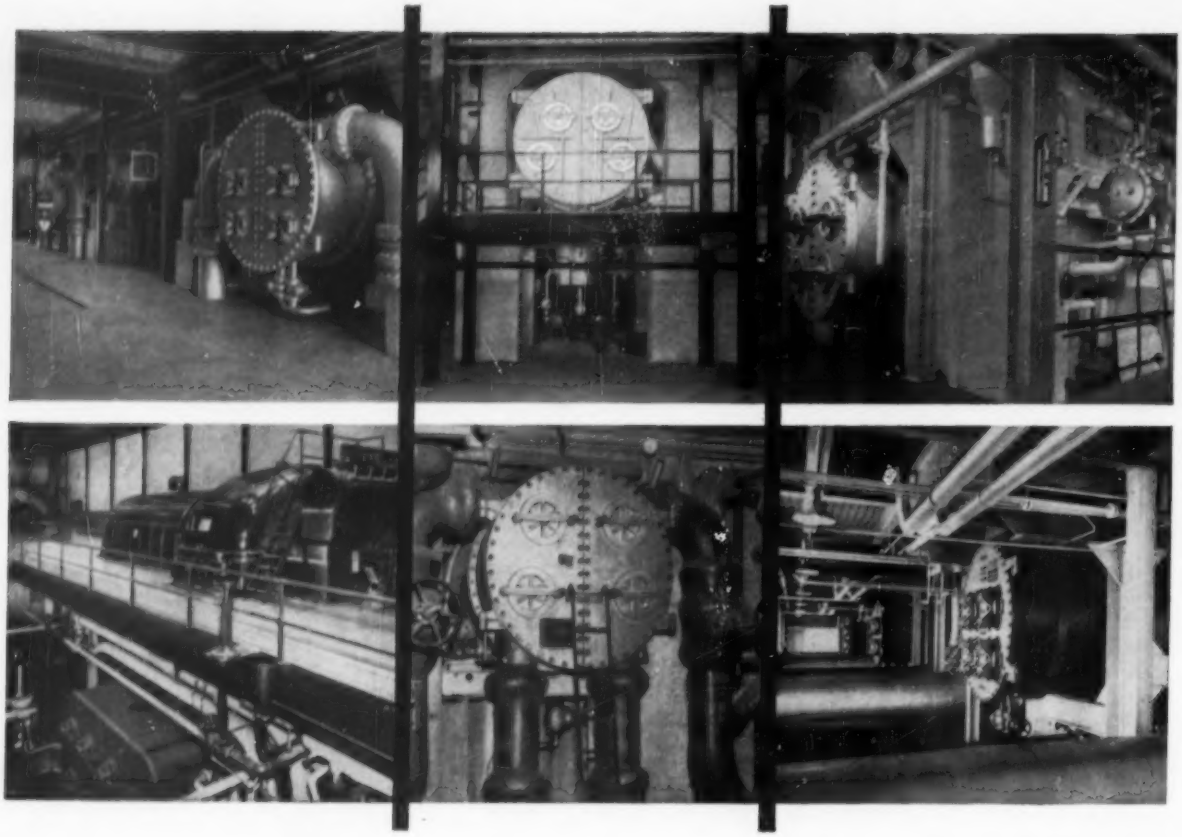
GENERAL ELECTRIC

For more data circle 511 on Post Card

the fame of a good product travels far . . .

ROSS SURFACE CONDENSERS

serve power plants everywhere



Pre-eminence of Ross engineering and manufacturing has won many customers . . . and kept them . . . here and abroad.

Public utilities, municipalities, industries, institutions, office buildings . . . some equipped with large twin bank designs, others with smaller single bank units . . . number among Ross installations which date back 40 years.

Long a leading, exclusive producer of heat exchange and condensing equipment . . . long a pace-setter with major innovations . . . Ross has a versatile experience to offer in the interpretation *and fulfiliment* of your requirements. Consulting engineers, contractors, architects or plant men . . . whoever specifies . . . all like to work with Ross engineers in the solution of condensing and heat exchange problems.

New Bulletin 8.2K1 gives you the reasons why. Write for your copy, please. Ross Heat Exchanger Division of American-Standard. 1473 West Ave., Buffalo 13, N. Y. In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

ROSS | ROSS HEAT EXCHANGER PRODUCTS

For more data circle 512 on Post Card

ALLIS-CHALMERS
Water Conditioning
ON THE JOB

Reporter finds solution to wide range of water problems

•Raw water is seldom suitable to meet specific requirements of the job. It usually needs some type of conditioning — best determined by a specialist. Here are typical examples of Allis-Chalmers water conditioning experience, equipment and chemicals in use.

Saved $22,000 First Year

Kansas—A chemical company plagued by high steam costs. Their boiler make-up water contained a high solids concentration, requiring a high blowdown rate.

After careful analysis of their problems, an Allis-Chalmers water conditioning engineer recommended Allis-Chalmers Anti-Foam. Use of this chemical resulted in increasing the solids concentration of the boiler water without carry-over. This, in turn, reduced the percentage of blowdown required.

Using A-C Anti-Foam, the company conservatively estimated first year savings of $22,000 in heat, water and chemicals.

* * *

Replacement of Condensate Return Lines Reduced to Practically Zero

Wisconsin—Here in one of the largest malt producing mills, several million pounds of steam are used daily for drying malt.

A special crew used to work all day every day doing nothing but replacing corroded condensate return lines. This, of course, was extremely costly.

Seven years ago, Allis-Chalmers water conditioning engineers were called in. Use of Allis-Chalmers No. 160 return line corrosion inhibitor was suggested.

Piping failures were reduced to the point where they only occur occasionally, and the maintenance crew has been assigned to other duties.

The Customer Is Always Right . . . Well, Most of the Time

East Coast — This plant had been using internal treatment of its boiler water. Chemical costs seemed excessive to management. After analyzing their own situation, they requested bids on a deionizer for treating makeup.

Instead of merely submitting a bid on the equipment specified, Allis-Chalmers engineers analyzed the water and the plant problem. This analysis showed that plant needs were such that a deionizer wasn't needed.

All that was needed was a de-alkalizer. Result: a savings of thousands of dollars.

* * *

The Case of the Dirty Dishes . . . or Don't Blame the Poor Dishwasher

Midwest — A harried plant cafeteria manager placed a frantic call to Allis-Chalmers water conditioning experts. Something was wrong. Glasses were spotty and plates had to be individually wiped off before they could be used. The grumbles were growing in the dining room . . . costs rising in the kitchen. His brand new $30,000 dishwasher wasn't getting the dishes clean, and the supplier of the dishwashing machine said the trouble was caused by the water.

The only trouble with that theory was that he had just installed a water softener the year before. The Allis-Chalmers water conditioning engineer examined the dishes coming out of the water and then asked to see the water softener. The problem was obviously hard water. The unit seemed to be in good working order and the tag indicated the softener had been recharged the previous day.

The maintenance man was called and asked to recharge the softener while an A-C engineer stood by. He went through all the steps—all but one, that is. He failed to close the bypass valve above the softener and practically none of the water went through the softener. It was then learned the operator was new and had not been properly trained.

Needless to say, the maintenance man is now an expert at operating the system, and everyone is pleased with the sparkling dishes.

Moral: A-C engineer's service covers the water front.

Expert Saves Steam for Drop Forge User

North Central — An Allis-Chalmers water conditioning engineer was called in by a manufacturer to supply water conditioning for makeup water. In checking the plant, here's what he found:

A large number of steam-operated drop forges are used by this company. The steam picked up oil from the pistons of the forge and was too contaminated for further use. It was dumped to waste.

He recommended installation of condensate oil removal filters. This was done and today practically all condensate is recovered. Makeup and water conditioning requirements are greatly reduced.

Problems Solved

For an answer to your industrial water problem, call the A-C office nearest you or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

WATER CONDITIONING • CHEMICALS, EQUIPMENT, SERVICE • FOR OVER 25 YEARS

A-C ALLIS-CHALMERS

A 5237

For more data circle 513 on Post Card

RILEY TURBO

solves six major central

Problem 1: **How to eliminate slagging on furnace walls and on other heating surfaces.**

Solution: Intertube Directional Flame Burners used with the Riley TURBO FURNACE are placed on one elevation, immediately above the furnace floor and are arranged for opposed firing. Combustion is substantially completed at the bottom of the combustion chamber. The upper furnace envelope area serves the purpose of cooling combustion gas to the required temperature for superheater and reheater. Combustion gas rises vertically in the secondary furnace without stratification and without impingement on furnace walls.

Problem 2: **How to reduce carbon loss to the minimum.**

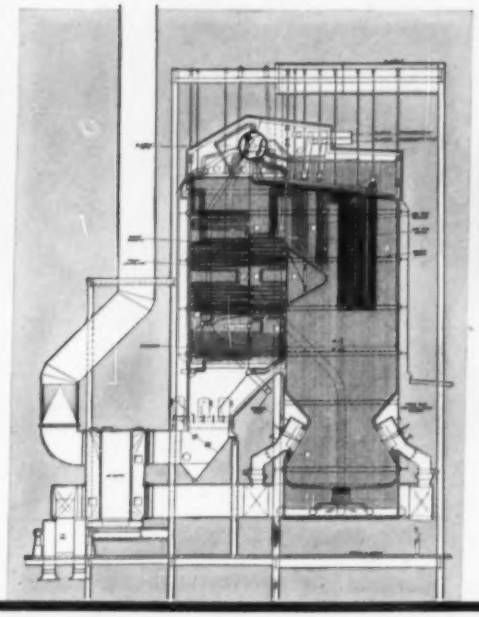
Solution: The combustion zone of the Riley TURBO FURNACE is a chamber of high temperature, long residence time, and extreme turbulence. Here pulverized coal particles are completely consumed with most of the ash reduced to molten slag.

Problem 3: **How to eliminate flyash disposal.**

Solution: The almost negligible trace of flyash carried in the flue gas of the Riley TURBO FURNACE is collected in rear pass hoppers and dust collectors and reinjected thru the burners for reburning of combustibles and final disposal as molten slag. Molten slag is quenched and removed as in any conventional slag tap furnace.

Problem 4: **How to change from gas and oil to solid fuels firing at less cost.**

Solution: Conventional type steam generating units designed to burn gas or oil must be taken out of service for extensive and costly alterations when converting to solid fuels firing. Because furnace exit gas temperatures are substantially the same for all fuels fired in the Riley TURBO FURNACE, immediate conversion to solid fuels without change to furnace and heating surfaces is possible.



FURNACE
station problems

Problem 5: **How to obtain uniform heat distribution to steam heating surfaces.**

Solution: The vertical direction of combustion gas leaving the TURBO FURNACE burning zone uniformly within the area of the vertical furnace walls insures equal furnace exit gas temperature from side to side and front to rear. Uniform heat absorbtion by superheater and reheater elements is thus assured.

Problem 6: **How to reduce operating costs.**

Solution: Burners on large conventional central station boilers are usually placed at several levels requiring complicated facilities for operation and supervision. Riley's TURBO FURNACE Directional Flame Burners are all located near the bottom of the furnace on one level. Plants can be designed so that the turbine, burner platform and control room are all on one floor level. Complete automatic electronic burner controls with fool-proof safeguards against flame failure are available for remote operating control.

Riley TURBO FURNACE boilers have been sold for capacities over one and one half million pounds of steam per hour. The operating characteristics of Riley TURBO FURNACES assure effficient performance when burning coal, oil, fluid coke, delayed coke, gas and lignite individually or in combination.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

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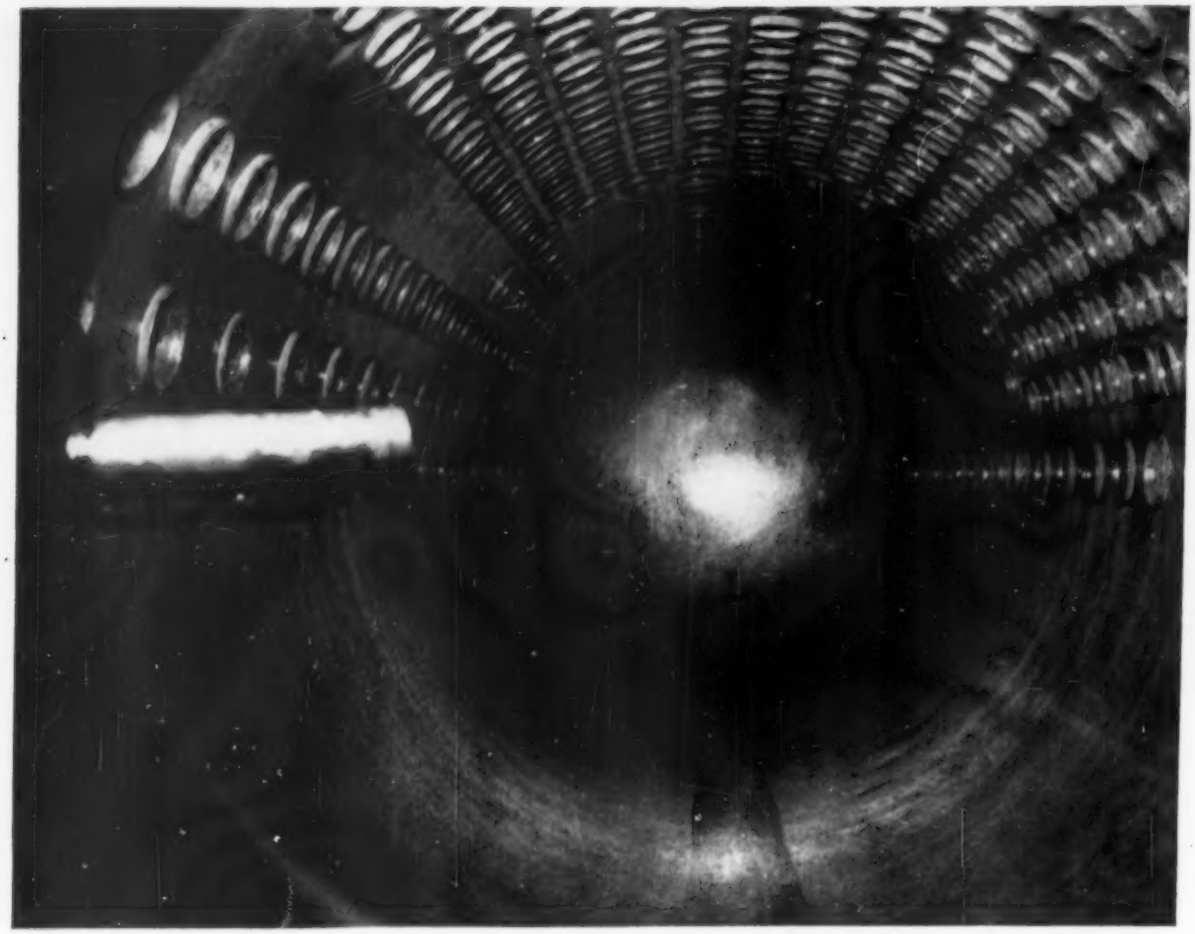

No Sludge . . . No Scale . . . No Corrosion in this boiler

Opened for inspection, this large boiler drum shows the results of a year's attention to good water treatment: *nothing!* No sludge, no scale, no corrosion . . . Ready to go back on line without even a wash-out . . . Down time and maintenance minimum, fuel economy and operating efficiency tops . . . Thanks to The Nalco System of Water Treatment, and good plant control practices.

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HELPFUL BULLETINS

ELECTRICAL

101 Re-Rated Motors — Form 3470, 8 pp, features re-rated motors with specially treated corrosion resistant steel housing which offers protection against all adverse weather conditions. Component features are described and illustrated, and details of construction and design shown in cutaway views and drawings. Robbins & Myers, Inc.

102 Protected Motors — This company's Tri/Clad 55 motors, 1 to 5 hp, dripproof and enclosed, are described in 12-pp Bulletin GEA-5983. Illustrates production testing techniques and construction features of the line, and discusses servicing and installation advantages. General Electric Co.

103 Synchronous Induction Motor — The Synduction motor, a synchronous induction machine for providing dependable constant speed, simplicity of operation and low first cost in a variety of industrial applications requiring 40 hp and below, is described in Bulletin 51B8440A. Features are described and application information and specifications are included. Allis-Chalmers Mfg. Co.

104 Shaded-Pole Motors — Bulletin GEA-6134A, 12 pp, describes shaded-pole motors for fan and blower applicatons in ratings 1.5 w through ¼ hp. Contains application, rating, and dimension data on 5½ in. (39-frame) motor rated 1/12 through ¼ hp, 5-in. (21-frame) motor rated 25 mph through ½ hp, 4-in. (11-frame) motor rated 15 mph through 35 mph, and 3½ in. (51-frame) motor rated 1.5 through 16 w. Shows product features and lists accessories available. General Electric Co.

105 Control Transformers — Bulletin GED-2767A, 32-pp, gives voltage rating, frequency, frame sizes, weight, application, price, and specification data on autotransformers, control panel and machine-tool transformers. It contains accessory information, wiring diagrams, and voltage regulation curves for use in selecting the proper transformer for a given application. Special application section gives similar data on a line of refrigerator transformers as well as normal, high-reactance and encapsulated transformers for oil-well, mine, pumphouse, and other locations. General Electric Co.

106 Butyl-Molded Transformers — Bulletin GED-3112, 12 pp, contains photos and information on the nine butyl-molded models which comprise a complete line of current transformers from a 600-v miniature to a 15,000-v outdoor type utilizing Hy-Bute/60 insulation. Construction features are illustrated, results of atmospheric tests recorded, and continuous thermal ratings shown. General Electric Co.

107 Switches and Relays — This 12-pp 1956–1957 catalog shows some 40 switches and relays ranging in size from standard size units to the miniature, and describes the operation and characteristics of each. Also shows new developments in switches and relays and gives complete specifications, size, capacities and other data. The Jaidinger Mfg. Co., Inc.

108 High-Speed Breakers — Bulletin 3004-A, 6 pp, contains descriptive and technical information about the FB line of high speed, current limiting d-c circuit breakers. Principal applications for generators, motors, anode protection and as feeder breakers are listed, and wiring diagrams and outline drawings are included. Operation is shown schematically. I-T-E Circuit Breaker Co.

109 High-Voltage Bushings — Twelve-pp Bulletin 508 describes paper-oil condenser bushings for high-voltage applications. Lists five bushing sizes, 15, 23, 34.5, 46 and 69 kv with complete description of the totally enclosed, paper-oil condenser type construction. Catalog numbers, ratings, dimensions and specifications, as well as photos and line drawings, are included. Lapp Insulator Co., Inc.

110 Wires and Cables — Interlocked armored cable, supports and fittings designed for low cost, heavy duty industrial, power or control wiring are described in this 24-pp bulletin. Photos and specific descriptions of various types of armored cables available for voltages through 15,000 v, single and multi-conductor are included. Arranged in table form are dimensional data, including conductor size, stranding, insulation, sheath and armor thickness, outer diameter and weight per thousand feet. Pertaining to fittings, charts show cable range, size requirements, catalog numbers and dimensions in inches. National Electric Products Corp.

111 Cathodic Protection Cable — Two kinds of cathodic protection cables are described in this informative bulletin. Special advantages of each are listed, and applications and specifications are given. General Cable Corp.

112 Solderless Wiring Devices — Bulletin 856, 8 pp, describes solderless wiring devices designed for easier, faster electrical connections. Complete specification information on various types of terminals and connectors is included. Electric Terminals Corp.

113 Outdoor Mercury Lighting — "How Mercury Vapor Outdoor Lighting Brings More Night Action," 8 pp, stresses low cost and versatility of mercury vapor lamps. Shows their use in such locations as industrial areas, parking lots. Includes data on company's new Silver White lamp, which offers an increase in efficiency over clear lamps. Also features Golden Mercury Vapor lamp, which privides a "warmer" light and is a natural caution light. Standard lamps are also discussed. Sylvania Electric Products, Inc.

PUMPS, COMPRESSORS

114 Proportioning Pumps — Bulletin 602, 8 pp, covers details and specifications of company's mechanical and hydraulic drive metering and proportioning pumps, their "meter that pumps," and their chemical metering pump. Capacity and pressure data are tabulated, and materials of construction are described. Hills-McCanna Co.

115 Reciprocating Pumps — Data Sheet 100 contains complete information on company's 25-hp to 2400-hp direct flow pumps, including the triplex (3 plunger), quintuplex, septuplex, and nonuplex reciprocating pumps. In addition to design and material specifications, it includes dimension tables and a pump selection chart. The Aldrich Pump Co.

116 High Vacuum Pumps — Recently increased performance ratings of company's rotary mechanical vacuum pumps, as well as other information on vacuum processing are contained in revised 28-pp Catalog 752. Includes, in addition to specifications for the complete line of pumps, tables of formulas, constants, and conversion factors frequently used in vacuum processing; solutions to problems of pump selection for typical vacuum systems; and information on continuous oil purification and other maintenance procedures for high vacuum pumps. Typical installations are pictured. F. J. Stokes Corp.

117 Steam Jet Vacuum Pumps — Bulletin 5H3, 8 pp, describes company's 3-, 4-, and 5-stage steam jet vacuum pumps and vacuum boosters, including both condensing and non-condensing types. It covers applications, features of the apparatus, materials of construction, and operation. Sizes and dimensions are given in tabular form along with performance characteristics for 3-stage vacuum pumps. Schutte and Koerting Co.

MECHANICAL POWER TRANSMISSION

118 Adjustable Speed Drives — Advantages and applications of adjustable speed Gyrol fluid drives are detailed in 8-pp Bulletin A-119. Cutaway view of typical unit is included, as well as selection tables, installation type drawings giving basic dimensions, and various mounting arrangements. American Blower Corp.

119 V-Belt Drives — This 16-pp engineering manual is organized to provide quickly the facts and figures on V-belt drives. The first section is devoted to drive service factors, instructions on how to select a stock drive, and complete drive tables for A, B, C, D and E section V-belts. A drive design section lists drive service factors, and provides designing instructions and data, as well as complete tables of horsepower ratings. A general information section provides further data and facts. Maurey Mfg. Corp.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 97 and 98.

120 Electric Power Drives — This 20-pp condensed catalog features a complete listing of prices and selection data for the more commonly used electric power drives. Covers normal speed electric motors, geared motors, variable speed transmissions and speed reducers. Tables sim-

plify selection, and diagrams illustrate dimensional details. Sterling Electric Motors, Inc.

121 Stock Sprockets — Design and operation advantages of the Grip-Master line of stock sprockets, roller chain flexible couplings, hubs and bushings are detailed in 20-pp Catalog 200A. Complete specifications are given in tabulated form, and photos and drawings illustrating important features are included. Cullman Wheel Co.

122 Flexible Couplings — Torsionally flexible Morflex couplings are described in 24-pp Catalog C41–56. The Morflex principle, employing preloaded rubber biscuits as the flexible medium, is explained and illustrated. Complete dimensions and specifications are given on standard, double, and radial type couplings with additional data on coupling driveshafts. Torsional deflection charts and instructions for use explain the method of coupling selection in controlling torsional vibration of a system. Morse Chain Co.

INSULATION

123 Pipe, Block Insulation — Form A-400 describes Hylo pipe covering and block insulation for high and low temperatures ranging down from 1600 to 100 F. Physical data, uses, application, and sizes are covered, and specifications included. The Eagle-Picher Co.

124 Glass Fiber Insulation — Microlite insulation, its performance and use, is described in 4-pp Form WML. In addition to providing thermal and acoustical performance charts, this bulletin tells how Microlite is made, and what it is made of. L-O-F Glass Fibers Co.

125 Insulation News Briefs — The September 1956 issue of the Armstrong Insulator features a number of interesting articles on industries and new developments in which manufacturer's insulations are utilized. Among the stories is one on the Table Rock Dam building project, another one telling about brewery by-products. Armstrong Cork Co.

VALVES, PIPING, FITTINGS

126 Automatic Valves — Cushioned automatic throttle and engine stop valves, steam and hydraulic check valves, steam pressure reducing and unloading valves, and non-return valves are described in this illustrated bulletin. Advantages are enumerated and sizes and pressure given. Golden-Anderson Valve Specialty Co.

127 Diaphragm Control Valve — Bulletin 980 describes the Type 30 valve which provides accurate pressure reduction and regulation of steam, water, air, brine and most liquids and gases. Includes detailed information on sizes, specifications and dimensions, pressure and temperature ratings, capacities, optional accessories and other data. A. W. Cash Co.

128 On Plug Valves — Section 5 of Reference Book 39 is a 28-pp catalog showing 100 per cent pipe area, venturi, round port, and diamond port lubricated plug valves in a variety of metals for 150-lb steam working pressure, 200-lb WOG, and ASA 150- and 300-lb classes. Complete with engineering dimensions, this catalog also shows different types of power operators for valves, in addition to complete lines of lever operated, worm and gear operated valves. Homestead Valve Mfg. Co.

129 Plastic Pipe — Chemical-resistant plastic pipe, fittings, and valves are described in 8-pp Bulletin CE-56, which includes technical properties, a table of resistance to chemicals, data on sizes, pressures, dimensions, and prices for pipe, fittings, and valves from ½ to 2 in. Instructions for threading, forming, and other installation operations are also given. American Hard Rubber Co.

130 PVC Pipe and Fittings — Complete data about the Van-Cor line of unplasticized polyvinyl chloride pipe, fittings and valves are given in this 16-pp engineering catalog. Covers both types — chemically-resistant, normal-impact and chemically-resistant, high-impact. Includes physical properties, chemical resistance tables, pipe, fitting and valve dimensions and flow rate charts, as well as pipe assembly and installation data. Colonial Plastics Mfg. Co.

131 Forged Steel Unions — Bulletin U-1-56, 8 pp, presents complete dimensional and engineering data on a line of forged steel unions for high pressure service. Types of unions described include forged steel unions, tongue and groove flange unions, orifice unions, tab orifice unions, clamp-ring unions, forged stainless steel unions, forged steel unions with bronze-to-steel and stainless-to-steel seats, and lug nut unions. W-S Fittings Div., H. K. Porter Co., Inc.

LUBRICATION

132 Lubricant Additive — Bulletin Lu-5, 12 pp, describes Moly-Sulfide lubricant additive which is designed to extend effective lubrication with a low-friction film. Summarizes lubricating characteristics of Moly-Sulfide-containing lubricants, describes advantages, and details applications, as well as results of field and laboratory tests for each application, and chemical and physical properties. Climax Molybdenum Co.

133 Power Lubrication — Bulletin 811, 8 pp, describes three types of power lubrication systems — air-operated, vacuum-operated and manually-operated. Typical installations are pictured and photos, drawings and diagrams showing operation and design features are included. Lincoln Engineering Co.

134 Improved Greases — Specialized greases are described in two new bulletins. A line of premium greases, the Prestige 40 series, are covered in Bulletin 50. These are for use where water, high temperature, or both, would shorten the life of most greases. Bulletin 49 describes two water-resistant extreme-temperature greases designed specifically for shock-loaded bearings. Sun Oil Co.

INSTRUMENTS AND CONTROLS

135 Control Operation Guide — Bulletin GEA-6372 is a 32-pp handbook explaining what each control product is, how it works, and where the device can be applied. Describes manual, magnetic, and reduced-voltage starters; push buttons; relays; limit switches; solenoids; pressure and vacuum, float, and plugging and anti-plugging switches. Photos, typical wiring diagrams, and cutaway views showing component features are included. General Electric Co.

136 Temperature Controllers — Bulletin MC-139 gives complete specifications on a new series of bulb-and-capillary indicating temperature controllers developed by this company. Tells how controller can be tailored to specific requirements by selecting from the proper "building blocks." Choices include three temperature ranges, three bulb sizes, single or dual control circuits and four basic switch types for various loads. Fenwal Inc.

137 Pneumatic Controllers — Bulletin A130, 56 pp, describes the Series 500W pneumatic controller, a high sensitivity, wide control-band controller for temperature, pressure, flow, vacuum and other control applications. Photos and drawings illustrating design and operation features, as well as sections on control principles, and various control modes, are included. Specifications for all models are listed, along with other technical data. The Bristol Co.

138 Flow Rate Measurement — Bulletin 18RG, 12 pp, describes company's line of Safeguard Rotameters, versatile variable area type instruments for the accurate measurement of fluid rate-of-flow. Principles are discussed and components common to all such flow measuring devices illustrated. Various types are described and data on application, construction, operation and installation included, as well as tables showing sizes, dimensions and capacities. Schutte and Koerting Co.

139 Plastic-Enclosed Thermostats — Bulletin MC-137 describes two types of thermoswitch units which are encased in plastic for service in highly humid or corrosive environments. Complete specifications are given and applications in plating, refrigeration, greenhouses, and in exposed highly humid atmospheres, corrosive mists, sprays are described. Fenwal Inc.

HEATING, COOLING

140 Heat Exchanger — Sixteen-pp Catalog 1156 covers removable tube bundle heat exchangers engineered for a wide range of heat transfer applications. Catalog contains all necessary design, capacity and dimension data required for selection and specification of exchangers for hydraulic equipment, diesel engines, gas engines, compressors, transformers, machine tools, cutting fluids and similar applications, and for chemical, pharmaceutical and food processing. Young Radiator Co.

141 Heating and Cooling Coils — Detailed information on heating and cooling coils for every heat transfer need is presented in this illustrated 36-pp catalog. Describes direct expansion Freon cooling coils, water coils and steam heating coils, and includes photos, drawings, performance tables, selection graphs, dimensional data, capacity tables, and a psychrometric chart. M. Blazer & Son.

WATER CONDITIONING

142 Copper Removal — This 8-pp development bulletin describes a method that permits removal of copper deposits from steam generating units in the same stage with water-formed deposits. Discusses nature of the problem, solution to the problem, and shows supporting laboratory data and field tests. Dowell Inc.

143 Blowdown System — Bulletin 65 describes a continuous blowdown system designed to maintain proper boiler water concentrations. A drawing showing

Inside Story on POWELL
PRESSURE SEAL VALVES

Pressure seal valves may appear similar on the outside. However, the Powell Pressure Seal Valves are quite different in design and in manufacture. And the inside story on Powell Pressure Seal Valves is that every valve has PERFORMANCE VERIFIED.

Only the finest materials are used in Powell Pressure Seal Valves, and painstaking quality control is rigidly enforced through each step of manufacture. For example, every machining operation is accurately gauged. All parts are thoroughly cleaned and degreased and thoroughly inspected.

Because of Powell's painstaking quality control, plant shutdown through valve failure is practically unknown. Records from power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE quality line which has PERFORMANCE VERIFIED.

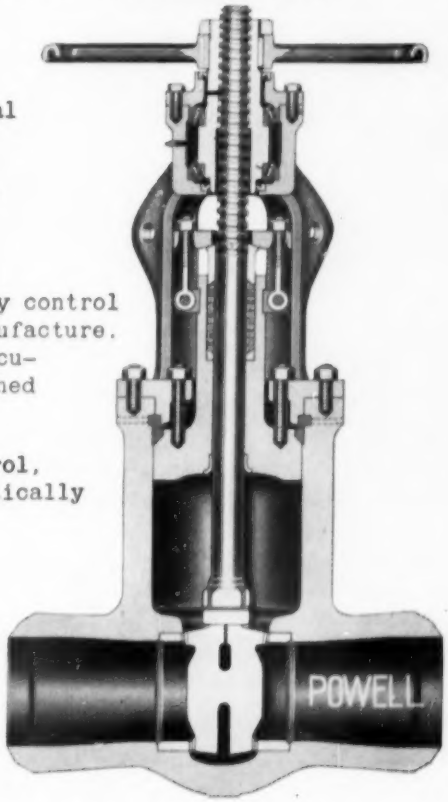

FIG. 11303 -- (Sectional) 1500-Pound Pressure Seal Steel Gate Valve

Fig. 1314-A -- 1500 Pound Integral Bonnet Steel "Y" Valve.

FIG. 11365 -- 1500-Pound Pressure Seal Piston Guided Horizontal Lift Check Valve

PERFORMANCE PV VERIFIED

The Wm. Powell Company, Cincinnati 22, Ohio . . . 111th YEAR

POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES

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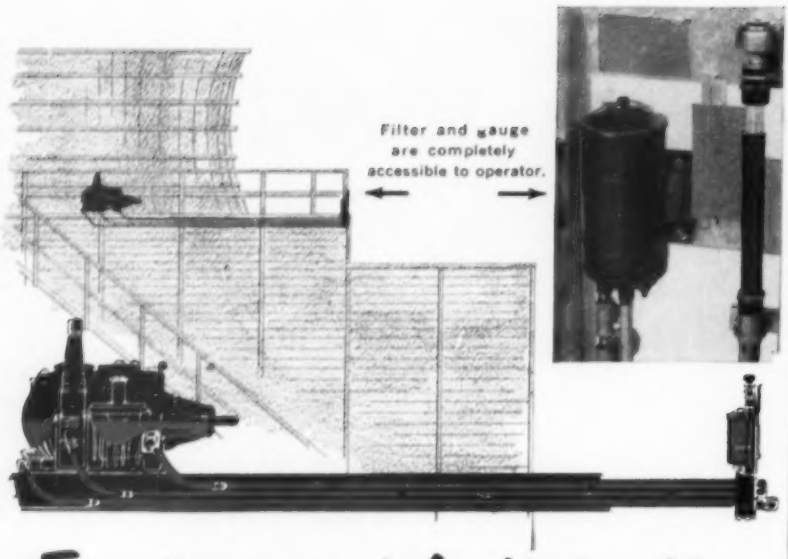

Engineered Lubrication
PAT. PENDING
for
COOLING TOWER POWER

Another important Marley first

"Clean Oil and Plenty of It!" That has always been the simple formula for long service life and low cost maintenance of cooling tower speed reducers. Now this standard can be attained and MAINTAINED by operators of towers equipped with Marley Packaged Tower Power, the only tower mechanical equipment that has ENGINEERED LUBRICATION.

Marley Engineered Lubrication provides a complete change of clean oil up to ten times during every hour of operation. By constantly circulating the oil through a renewable cartridge filter all particles of foreign matter, sludge and emulsion are removed, not once every six months but minute by minute. With Marley Engineered Lubrication, clean oil stays clean; it is not subject to progressive contamination from the moment it is put in service.

Engineered Lubrication gives the operator safe, logical, full-time control. With both filter and sight-gauge mounted outside the fan cylinder and always in view he takes nothing for granted. He knows the oil level in every Geareducer at all times. He can obtain oil samples for testing without shutting down the fan.

Engineered Lubrication is an epochal advancement in cooling tower service and operating economy. The Marley engineer in your nearest major city awaits an opportunity to show you how it functions without wear on any parts of the centrifugal-type flow system, without added power, without effort. Call him or write

Founder Member of Cooling Tower Institute

MARLEY **The Marley Company**

Kansas City, Missouri

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components is included, advantages are listed, and physical details given. The Whitlock Mfg. Co.

. . . *Outstanding Among This Month's Catalogs*

145 Circuit Breaker Suggestions — A method of co-ordinating molded case circuit breakers with current-limiting fuses for protecting low-voltage feeder circuits against fault currents up to 100,000 amp (RMS asymmetrical) is described in 8-pp Bulletin GEA-6569. Describes how method can be employed in planning new systems and in replacing inadequate systems where there is a need for high levels of interrupting capacity. Tables showing proper fuses to co-ordinate with standard breakers for applications at high short-circuit duties up to 100,000 amp are included. General Electric Co.

146 Heating, Ventilating Equipment — The 38-pp 1956 Estimating Catalog lists price revisions and describes product improvements for a broad line of air conditioning, ventilation, refrigeration and heating supplies and equipment, and includes complete technical and dimensional data. Most of the engineering data are presented in the form of tables and graphs, profusely illustrated with photos, drawings and diagrams. M. Blazer & Son.

TOOLS

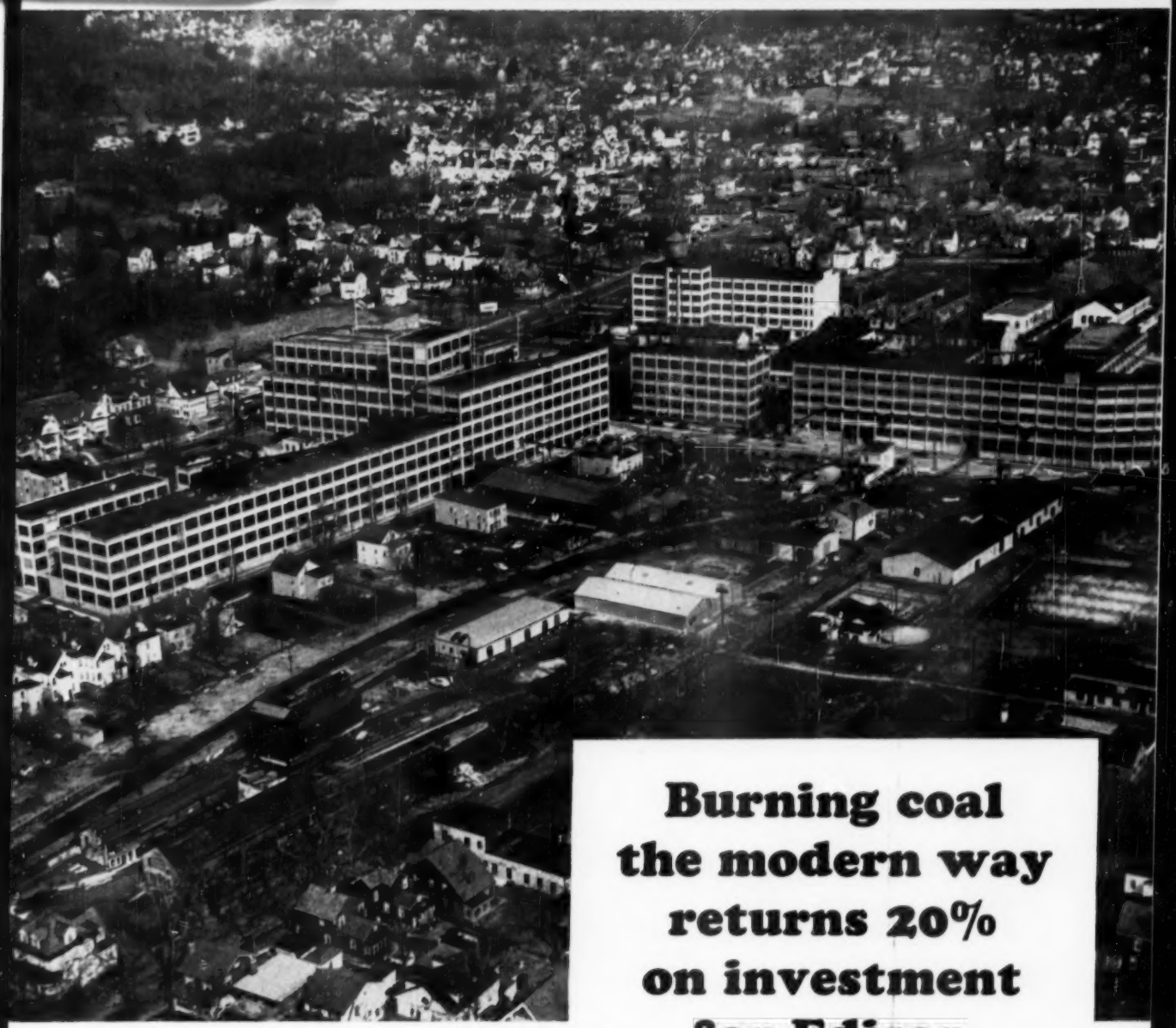
147 Tube-Working Tools — Catalog 1140, 24 pp, covers company's hand tools — tube cutters, flarers, benders — also bench-mounted benders, power flarer, straight thread tapping and counter-boring tools. Includes a section on how to use the tools, as well as photos, drawings and complete specifications. Parker Appliance Co.

148 Air Hammers — This data and price catalog sheet covers company's Series IP straight impact hand model air hammers. Pictures, gives parts and prices as well as brief specifications on models 100, 200, 300 and 400 hammers for rivet capacities ⅛ in. through ¼ in. Lemert Engineering Co., Inc.

OTHER EQUIPMENT

150 Wood Drying System — Bulletin 1232, 8 pp, describes the Dryalator, a packaged device for automatically drying lumber for use by lumber and furniture manufacturers and for producers of products which incorporate components made of wood. Illustration showing equipment, with pneumatic recording control, steam heating coils, and instrumentation are provided, as well as operating views of kiln. A table of drying speeds, schematic drawings, and specifications are included. Orr & Sembower, Inc.

151 Dust Control — Specially engineered systems, known as Chem-Jet Systems, for controlling dust in industrial and utility power plants are described in this illustrated bulletin. Various handling points are defined and illustrated, applications are pictured, and a chart showing moisture requirements per ton of coal of the compound as compared with water is included. The Johnson-March Corp.



Burning coal the modern way returns 20% on investment for Edison

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

The firm of Thomas A. Edison, Inc., West Orange, N. J., was faced with a common problem—rising steam plant costs. A thorough survey indicated the need for modernization of the power system. As a result, six 30-year old boilers were replaced with two 60,000 lb./hr. units. FD and ID fans, pneumatic ash systems, coal pulverizers and related equipment were installed.

Modernization has paid off at Edison! Steam-generating capacity per sq. ft. of boiler room space has been doubled, labor costs have been cut, fuel costs are down, boiler efficiency is up 16% and modernization gives a 20% annual return on a net investment of 2.7 mils per BTU!

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

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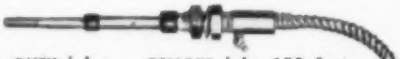
WHICH OF THESE CHARACTERISTICS ARE ESSENTIALS ON YOUR REMOTE CONTROL JOBS?

Accuracy . . . High Load Capacity . . . Adaptability . . . Freedom from Trouble . . . Long Life . . . Flexibility . . . these are some of the qualities of **ACCO TRU-LAY PUSH-PULL FLEXIBLE CONTROLS** that have made it possible to improve the operation of literally hundreds of mechanical products (list on request). Full description of this versatile REMOTE CONTROL is given in our **DATA FILE** available for your further study.



ACCURACY is inherent in the basic design, and in the standards of quality and precise dimension that control the manufacture of TRU-LAY PUSH-PULL CONTROLS. These are precision products, not gadgets.

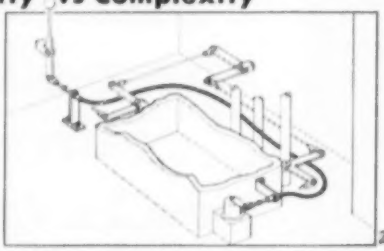
VERSATILITY of this fine remote control can best be illustrated by citing some of the jobs it handles well . . . **HOT** jobs on jets and industrial furnaces . . . **COLD** jobs down to —70° F. . . . **WET** jobs (the conduit can be completely immersed) . . . **DIRTY** jobs . . . **ABRASIVE** jobs . . . **CORROSIVE** jobs . . . **HEAVY, TOUGH** jobs up to 1,000 lbs input . . . **LIGHT DUTY** jobs . . . **REMOTE** jobs 150 feet or more from the control point . . . these units are frequently and successfully used in conjunction with electric, hydraulic and air controls . . . are thoroughly effective under almost any operating condition.

"SOLID as a rod but FLEXIBLE as a wire rope" aptly describes TRU-LAY PUSH-PULL CONTROLS. This *flexibility* provides positive, remote action whether anchorages are fixed or movable . . . it damps out noise and vibration—protects delicate instruments . . . it permits ease of handling and shipping even when assemblies are 100 or 150 feet long . . . it avoids the risk of damage always present with solid tubular controls that must be preformed to position . . . and flexibility greatly simplifies installation of controls by reducing the number of working parts and by making it possible to snake around obstructions. . .

Advantages of Tru-Lay Push-Pull flexibility and simplicity are pictured below

Simplicity vs Complexity

Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased backlash, lost accuracy and vibration rattles.



ADAPTABILITY to all sorts of mechanical situations explains, in large measure, the wide-spread application of TRU-LAY PUSH-PULLS. Standard anchorages, fittings and heads have been designed that meet requirements on approximately 80% of the installations. Simple modifications of these standards, or minor changes in your own design, cover almost every special situation. Our engineers have the know-how on such matters.

FREEDOM FROM TROUBLE and **LONG LIFE** are assured even under exceptionally adverse operating conditions because of such things as . . . full protection of the flexible, inner, working member by the tough flexible conduit . . . lubrication of the inner, working member *for life* during assembly . . . seals that keep moisture, dust and other foreign matter out of the unit . . . cold swaging of fittings that makes them integral parts of the control unit. (Full construction details in our **DATA FILE**). We have never heard of a TRU-LAY FLEXIBLE PUSH-PULL CONTROL wearing out in normal service.

Whether your interest is in a single application of this versatile PUSH-PULL CONTROL, or in its inclusion as a component of the product you manufacture, the six booklets and bulletins in this **DATA FILE** will answer your further questions, and will also provide you with the means of defining to us the application you may be interested in.

The six bulletins and booklets in the DATA FILE will answer all your further questions. Write for your copy.

ACCO

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AMERICAN CHAIN & CABLE

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Push-Pull DATA FILE

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152 Industrial Gloves — This 16-pp catalog illustrates and describes a line of industrial gloves and finger cots, including curved-finger rubber, latex, Neoprene, Buna-N, and Compar plastic gloves. A chart of finger cot sizes in actual diameters and a recommended use table showing resistance ratings of various glove materials to 199 chemicals and solvents commonly used in industry are included. The Wilson Rubber Co.

153 Atomic Power Plants — Competitive power from the atom and capabilities of this company to supply reactor power plants are covered in this 12-pp bulletin. It features a 5-pp transvision of a pressurized water reactor core. Describes company's work in the field of atomic power, pictures new criticality facility, and contains a line drawing of a typical nuclear power design with an accompanying characteristics chart. Alco Products, Inc.

154 Gaskets for Industry — This 28-pp catalog is offered as a help to users of gaskets, shims and washers, and illustrates and describes a variety of styles, shapes and materials. It includes data on ring, cylinder head, double jacket, corrugated metal, plain solid, self-sealing, and special types of gaskets as well as gaskets cut from a wide range of materials. A special feature of the book is a complete section listing more than 1500 stock dies available. Chicago-Wilcox Mfg. Co.

155 Vertical Pressure Filters — Publications 6319 and 6320 provide complete details on vertical pressure filters with positive foolproof filter control, for use in industrial plants and other types of institutional and commercial applications. Bulletins furnish operating details, data on filter bed materials, available accessories, as well as drawings showing various arrangements of two, three and four header units. Cochrane Corp.

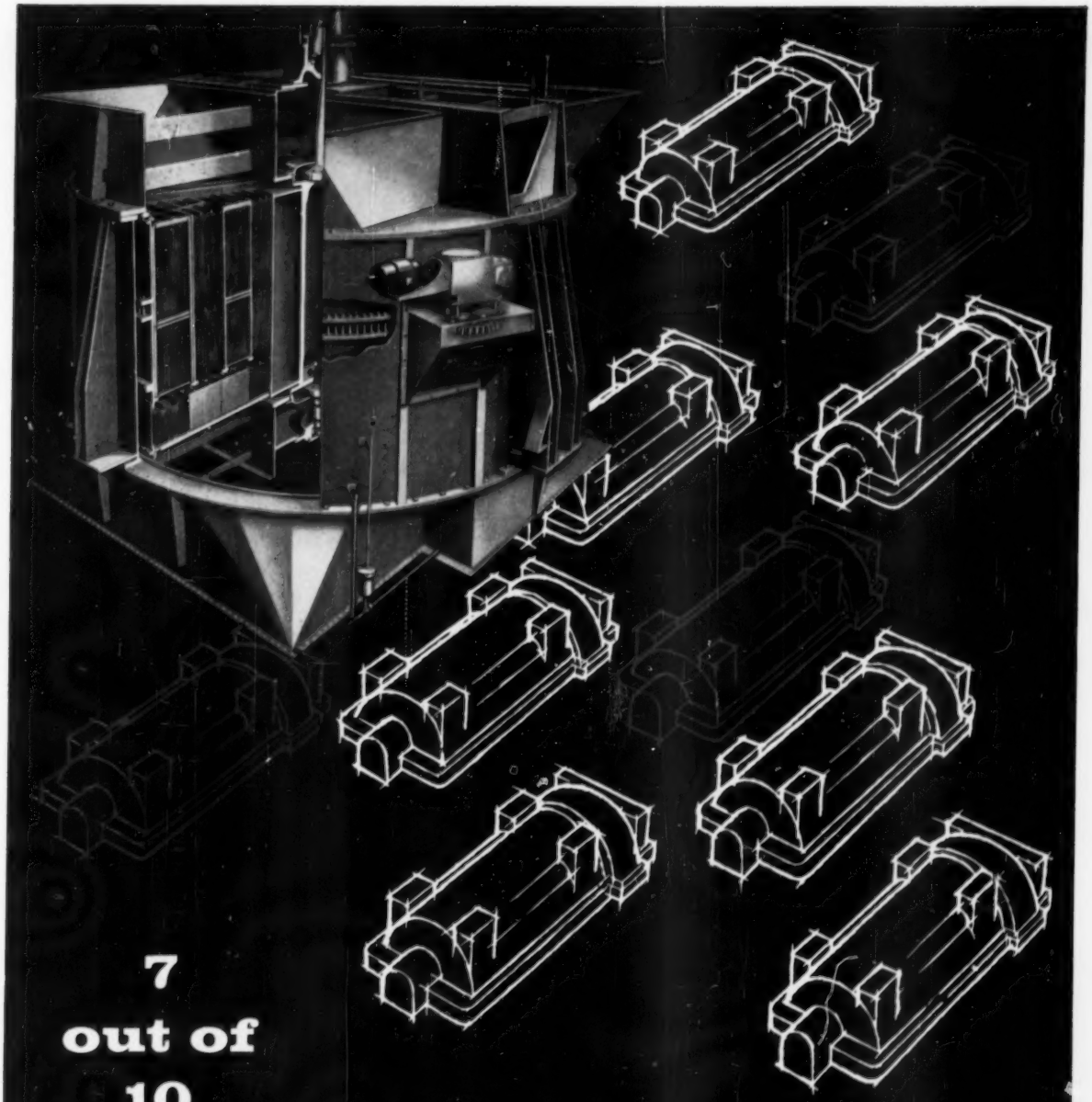
You'll save time in ordering bulletins by using the Reader Service Cards on page 97. Of course we honor letterhead requests—but it takes us somewhat longer to handle them.

156 Refractory Materials — Bulletin RB-20 is an 8-pp condensed catalog presenting company's line of fired refractory materials, covering 19 standard brands of refractory brick, for application in steel, ceramics, glass, cement, brick and clay, foundry, heat treating, petroleum, chemical and power industries. Classification, properties and applications of each brand are listed, and a selection chart and data chart giving detailed information on 23 mortars is included. Richard C. Remmey Son Co.

157 Tractor Operator's Guide — Excellent tips on how to handle wheel tractors and scrapers are presented in this 24-pp booklet. Clearly illustrated in color, covers such operations as shifting, loading, bowl control, apron control, hauling to the fill, dumping. Provides handy operator's check list covering what to do before starting engine, during warm-up, on leaving parking area. Caterpillar Tractor Co.

158 Metal Laminates — Types of metal laminates, metals which can be laminated, and use in heat exchangers, electronics and other applications are

For more data circle 518 on Post Card



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air preheater installations are Ljungstrom®

Advantages of the Ljungstrom Air Preheater

- Size for size, recovers far more heat than any other type.
- Reduces fuel consumption. Permits use of lower grade fuels. Increases boiler output and reliability.
- Eliminates cold spots . . . keeps corrosion to a minimum.
- Easier, faster to clean and maintain.
- Requires far less supporting steel and is quickly erected.

MINIMUM MAINTENANCE is one of the many important reasons. More complete combustion of fuel results in far less slagging, and gases entering dust-recovery units are cleaner. There's less corrosion. Insertion of new elements can be done in as short a time as four hours. You can even inspect the Ljungstrom through a built-in port while the unit is in operation.

For the interesting full story, send for a free copy of our 38-page manual.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

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DOUBLE BOILER BLOW-OFF SAFETY

1

Quick-Operating EVERLASTING Straight-Through Valve

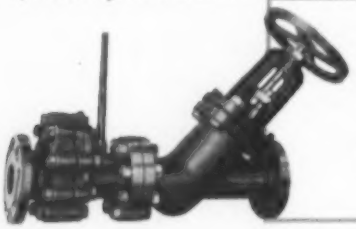
The standard Everlasting design which opens with a quarter-turn of the lever and closes with a drop-tight seal that actually improves with use.

2

Shock-Resisting EVERLASTING Angle Valve

Specially designed and stoutly constructed to withstand severe service and the shocks and abrasion of blow-down solids.

Conform with ASME codes. Available in a range of sizes for pressures up to 600 psig. *Write for descriptive bulletin.*



EVERLASTING DUPLEX UNITS

also available with Y Valves and in any combination of Quick-Operating, Angle and Y Valves.

For "everlasting" service, use

EVERLASTING Valves

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EV 360

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detailed in this illustrated 8-pp bulletin. Advantages and properties are described, and size and other data given. Bridgeport Brass Co.

159 Humidification Facts — Bulletin 492 offers pertinent facts on the subject of humidification for industry. Lists advantages of controlled humidification and describes various types of humidifiers to suit a variety of industrial requirements. Abbeon Supply Co.

160 Flexible Shaft Machine— Grinding, sanding, polishing, buffing, wire brushing, sanding wood, and drilling in steel or wood can be done with attachments by the ¼ hp multi-speed or single speed flexible shaft machine illustrated in 8-pp Catalog 57. A complete line of accessories, flexible tool shafts, power drive shafts, and drill shafts is also covered. Stow Mfg. Co.

161 For Snow Removal — Form MS-1147 describes a wide range of snow removal equipment for a variety of snow removal jobs, including "V" plows, wings, blade plows, loading buckets and bulldozer blades. Size and capacity data are included. Allis-Chalmers Mfg. Co.

162 Report on Standards — Evidence of the value of standardization in the field of power generation is stressed in an extensive survey report, "Dollar Savings Through Standards," which highlights economic benefits to American industry resulting from the use of standards. The 40-pp survey contains 79 documented case studies covering 27 industrial fields. American Standard Association.

163 Heavy Duty Fans — Eight-pp Bulletin 4824 describes new Airfoil centrifugal fans for heavy duty industrial applications. Discusses performance features and construction details of the fans. Text is supplemented with photos and drawings of wheel, housing, bearing, shaft. Several possible volume control methods that can be used with these fans are described and evaluated. Brake horsepower curves for four volume control methods are included. American Blower Corp.

164 Flaw Location — "How to Perform Dye Penetrant Inspections" is a semi-technical booklet, designed as a manual for performing inspections by the penetrant process. Discusses every aspect of penetrant flaw location — pre-cleaning, applying, removing excess penetrant, applying developer and interpreting results. A "dwell time" chart is included. Turco Products, Inc.

165 Compensating Feed Stoker — Design and operating advantages of company's modified travelling grate type stoker that compensates for loss of volume in the fuel bed as combustibles are burned out are described in this 20-pp bulletin. A variety of installations are covered, typical heat balance table is included, and dimensions and diagrams given. The Johnston & Jennings Co.

166 Packaged Boilers — Bulletin 1233 describes Power-Pak packaged automatic boilers for steam or hot water heating and hot water service, in capacities from 8 to 25 hp, for pressures to 15 psi. Provides detailed illustrations of oil- and gas-fired units, lists features and advantages, and tabulates dimensions, weights, and ratings. Orr & Sembower, Inc.

Another Feature of the FW Series "SC" Standard Boiler

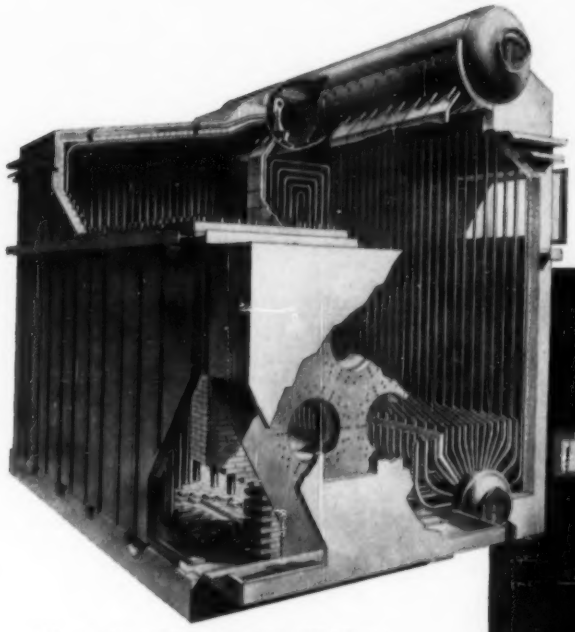
PRESSURE-TIGHT CASING

permits

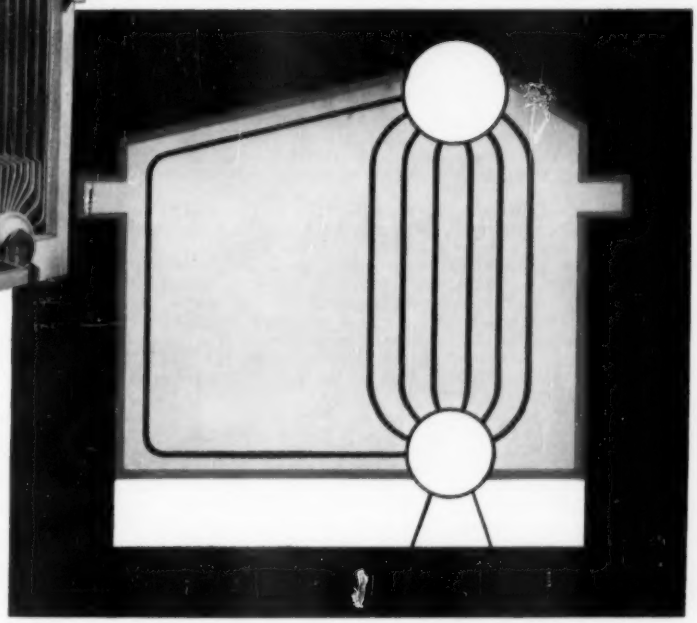
LOWER OPERATING COST

through

MORE EFFICIENT COMBUSTION



Cut-away view of Foster Wheeler "SC" Series Standard Steam Generator



OTHER FEATURES AT A GLANCE

- Completely water-cooled walls
- Over 19-foot firing depth
- Unrestricted circulation
- Fully drainable superheater
- Efficient convection surface
- Bottom supported unit
- Steam purifying system
- Full insulation

THE ALL-WELDED steel casing of the Foster Wheeler Series "SC" Steam Generator forms a rigid, pressure-tight unit which can be arranged for either pressurized or balanced-draft operation.

By eliminating all possible sources of air or gas leakage, this pressure-tight design increases combustion efficiency and contributes to higher fuel economy per pound of steam per hour. No sliding seals are necessary as the stationary casing is welded to the drums and the differential in expansion provided for by an integral horizontal expansion joint which encircles the entire unit. Pressure-tight ports are provided for observation of burners and flame.

These cost-saving FW Series "SC" Steam Generators are available in capacities from 50,000 to 150,000 lb/hr, for pressures to 1500 psi and superheated steam temperatures to 950F. For further information, write for Bulletin B-55-4. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

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CONSTRUCTION NEWS

Birmingham, Ala. — Alabama Power Co, Alabama Power Co Bldg, has plans under consideration and has filed a certificate of application with the Alabama Public Service Commission for permission to construct a multiple purpose dam on the Sipsey Fork, of the Warrior River, in Alabama and to install power generating facilities in the existing United States dam, Lock No. 17. New facilities, which will conform to the comprehensive plan for development of the upper basin of the river, will represent an investment of approximately $37,000,000, when completed.

Tempe, Ariz. — Arizona Public Service Co, 501 S Third St, Phoenix, Ariz., has plans under consideration for a new power plant with an initial capacity of 220,000 kw. Work will get under way in early 1957 and is scheduled to be placed in production by late 1959. Cost of entire installation reported to cost approximately $28,000,000.

Fresno, Calif. — Pacific Gas & Electric Co, 245 Market St, San Francisco, Calif., has announced plans for the construction of a 6½-mile tunnel and underground hydroelectric power plant, on the north fork of the Kings River in Fresno County, about 30 miles northeast of here. The $80,000,000 Kings River development, to be completed in 1961, includes construction of two new dams, Courtright and Wishon, 10 miles of new tunnels, and construction of the Haas and Kings River powerhouses. When completed, project will add 261,500 kw of generating capacity to company system.

Atlanta, Ga. — Georgia Power Co, Electric & Gas Bldg, has announced plans for the purchase of all of the properties of the Georgia Light & Power Co, a subsidiary of the Florida Power Co, St. Petersburg, Fla. Georgia Power & Light Co serves 19 south Georgia counties and upon completion of the sale in the early part of 1957, at a reported price of $10,000,000 in cash and assumption of $6,500,000 in bonded indebtedness, will be known as the Valdosta Division of the Georgia Power Co. Sale will include all of the transmission facilities as well as two standby generating units with a combined capacity of 9,000 kw.

Arco, Idaho — The Atomic Energy Commission, Idaho Operations Office, Idaho Falls, Idaho, has announced plans for the construction of structural steel reactor building measuring 60 ft by about 80 ft, to be used in the development of an atom-powered airplane. Plans include buildings, utilities and other facilities at National Reactor Testing Station to cost an estimated $22,000,000. The Ralph M. Parsons Co, Los Angeles, Calif., has been awarded contract for designing a test building, a shielded control and equipment building, and supporting facilities. Construction is scheduled to get under way in the spring of 1957.

East Chicago, Ind. — Northern Indiana Public Service Co, 5265 Hohman Ave, Hammond, Ind., has plans under consideration for the construction of new power plant near here. Plans call for the installation of two steam-electric generating units, capacity not announced as yet, at an estimated cost to exceed $40,000,000. Construction of the new plant is projected for the spring of 1957. Sargent & Lundy, consulting engineers.

Coggan, Iowa — The Board of Trustees of the Municipal Electric Light and Power Department has approved plans for the improvement and expansion of municipal electric light & power plant. Work will include the installation of a diesel engine generating unit, with auxiliary equipment and foundation, with a sea level rating at 80 per cent power factor of not less than 475 kw and not more than 600 kw at a rotating speed of 720 rpm. Switchboard additions and auxiliary electrical work for complete installation will be provided. Plant will be in operation by early 1957.

Rowe, Mass. — Yankee Atomic Electric Co, Boston, Mass., comprising 12 New England electric utilities has plans under consideration for the construction of an atomic electric power plant here. Company has petitioned the Massachusetts Department of Public Utilities for authority to undertake interim financing in the amount of $1,000,000. Company also proposes to issue an additional $1,000,000 in stocks and notes, proceeds of which would be used for the construction of the project. Companies sponsoring the Yankee Atomic project will purchase the new issues in a ratio proportionate to their present holdings. Project reported to be a $35,000,000 investment, when completed.

Monroe, Mich. — The Power Reactor Development Co, whose membership consists of 18 utility companies and 8 industrial concerns, has announced plans and work is already under way on the construction of Michigan's first atomic-electric power plant, officially named the Enrico Fermi Atomic Power Plant in honor of Dr. Enrico Fermi. Power plant will be built on a 900-acre site at Lagoona Beach on the shores of Lake Erie, 7 miles north of here. Work will consist of 2 phases, the $40,511,000 reactor plant, and the $14,061,000 turbine electric plant. The reactor plant will have a power capacity of 300,000 kw and the turbines, a capacity of 100,000 kw, when completed in 1960.

Rochester, Minn. — International Business Machines Corp, 590 Madison Ave, New York 22, N. Y., has authorized plans for the construction of new plant comprising 3 one-story buildings with a total area of 565,000 sq ft. Plans include manufacturing facilities, administrative offices, boiler house, installations and warehouse facilities. Plant when completed late in 1957 is reported to cost $8,000,000. Johnson, Drake & Piper, Inc, Baker Bldg, Minneapolis, Minn., are construction engineers.

Pleasant Hill, Mo. — Missouri Public Service Co, 3869 Park St, Kansas City, Mo., has plans under way for addition to local power plant here, known as the Ralph Green Electric Power Station. New turbine generator with an initial capacity of 24,000 kw will be installed at a reported cost approximating more than $3,700,000. Long Construction Co, 810 Rialto Bldg, Kansas City, Mo., has charge of construction of the new unit, foundations and superstructure, which will include the installation of a second cooling tower.

New York, N. Y. — Consolidated Edison Co, of New York, Inc, 4 Irving Place, has arranged financing in the amount of $40,000,000, proceeds of which will be used to pay off cost of current construction program. Company estimates that $650,000,000 will be spent on expansion and improvement of facilities through 1960. Work is currently under way on increased plant and generating expansion, power substations, transmission facilities, and other work.

Piqua, Ohio — The City of Piqua has plans under consideration for the construction of municipal nuclear power plant. The design and development of the plant has already been authorized by the AEC and work is scheduled to begin soon. The North American Aviation Co, Los Angeles International Airport, Los Angeles, Calif., are consulting engineers of the project, reported to cost approximately $4,000,000.

Philadelphia, Penna. — Eight Power & Light companies with combined generating facilities of 9,877,250 kw, have announced the formation of the Pennsylvania-New Jersey-Maryland Interconnection and have linked their facilities to form an electric pool to provide more efficient and dependable electric service in a 48,000 sq mi, 3-state area, supplying power and electricity to more than 5,000,000 customers. In emergencies, the network, comprising Philadelphia Electric Co, Public Service Electric & Gas Co, Pennsylvania Power & Light Co, Metropolitan Edison Co, Pennsylvania Electric Co, New Jersey Power & Light Co, Jersey Central Power & Light Co, and Baltimore Gas & Electric Co, can send power beyond present territorial boundaries.

Fort Worth, Tex. — Texas Electric Service Co, 406 W Seventh St, Fort Worth, has authorized plans for expansion of local steam-electric generating station, with installation of a new generating unit and auxiliary equipment, for increased capacity. Work calls for installation of new steam-electric generating unit and new distribution lines at local facilities here and at Monahans, Tex. Total cost of expansion, including generating facilities estimated to cost approximately $9,000,000 reported to be about $9,500,000. Morris & Robertson Contractors, Wichita Falls, Tex., are in charge of construction.

Portsmouth, Va. — Virginia Electric Power Co, Richmond, Va., has announced plans for expansion and additions to generating facilities at local Portsmouth power station, for increased capacity. New steam-electric generating unit with an initial capacity of 175,000 kw will be installed for cutting in to company's system by mid-1959. New unit will increase utility's capacity to 350,000 kw when placed in line and is reported to cost $24,000,000. Expansion was made necessary by power demands from North Carolina service area and industrial and commercial expansion in the Tidewater area.

Roanoke, Va. — Appalachian Electric Power Co, 129 Campbell Ave, has announced plans for the development of the long debated Smith Mountain Dam project, at an estimated cost of more than $20,000,000. Application was filed recently with the FPC for a preliminary permit for construction of the dam and a hydroelectric power plant with an initial capacity of 60,000 kw. Work will get under way as soon as application has been approved.

How it Works!

Only new Sarco TD steam trap uses kinetic energy of steam to close valve

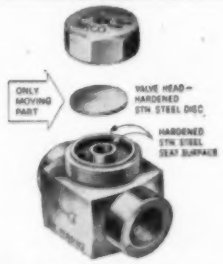
GAS MANTLES have been replaced by electric lights, steam locomotives by diesels, propeller planes by jets.

Now, the use of the kinetic energy of steam principle gives us a modern type of steam trap.

The Sarco TD obsoletes all other types for most 10 to 600 psi installations. For example, it operates without a valve closing device—no bucket, float, bellows, pins, levers or gaskets.

Glance below and you'll agree that no other steam trap is even similar to the Sarco TD!

For a trial installation—write today.



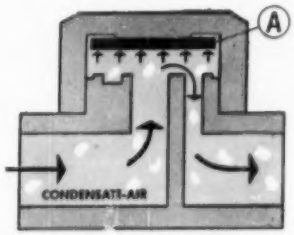
Only 3 parts... all stainless steel

Sizes ⅜ to 1"—each body is as small as a tee fitting! Capacity is determined not by a bulky body but by the effective orifice, valve action, pressure drop and condensate temperature.

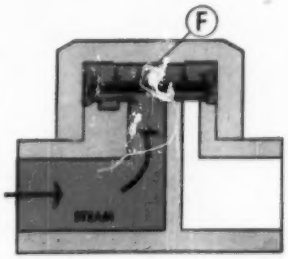
Many Advantages

1. *Practically no maintenance*—no valve mechanism, no narrow channels. Trouble-free simple design. Only 3 parts—all stainless steel.
2. *One trap for all pressures*—self-adjusting. One large capacity seat for 600 psi as for 10 psi. No changes or adjustments.
3. *Operates equally well on all loads*—on heavy, light or no condensate load No prime to lose. No adjustments.
4. *No steam leak required*—to operate the Sarco TD. Closes tight against steam
5. *Discharges at steam temperature and vents air* and air-steam mixtures at start-up and during operation.
6. *Freeze-proof*—when installed with outlet down, free to drain.

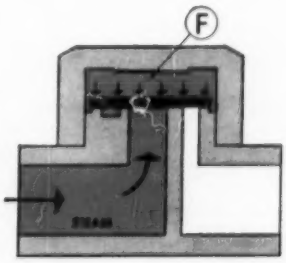
Only Sarco TD Thermodynamic Steam Trap Uses This Unique Operating Principle Which Permits Trouble-Free TD Design



1. Inlet pressure raises disc "A" from seat... immediate discharge of air and condensate at steam temperature.



2. Steam follows the condensate and the high velocity jet across the bottom of disc "A" creates a low pressure area (Bernoulli effect)... the jet is deflected into chamber "F" where it builds up pressure by recompression and this pressure acts on the top of the disc "A"...



3. Pressure in chamber "F", acting on full top area of disc "A", exceeds force of incoming steam and low pressure area under the disc...and immediately forces it down, closing the inlet. As condensation decreases the pressure in chamber "F", the disc rises and steps 1 or 2 repeat.

60-day trial convinces... No obligation... Use coupon!

SARCO

Steam Traps—Temperature Regulators—Strainers—Heating Specialties

SARCO COMPANY, INC., Empire State Bldg., New York 1, N. Y.

Please send me Sarco TD Steam Trap and strainer for 60-day trial. Size_____

For installation on_____

Name_____ Title_____

Firm_____

Address_____

City_____ State_____

2184-C

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EQUIPMENT NEWS

1—MECHANICAL SEAL for high pressure boiler feed pumps

This boiler feed pump mechanical seal is claimed to need no further attention and replacement of sleeves once installed. According to company, loss of feed water is prevented, since there is no leakage, and long seal life is obtained through the use of a special closed circulating system which provides cool water in sealing chamber. The seal comes engineered for the particular operation, including adaptation to pump design and piping arrangement. Plans and all necessary recommendations are supplied and heat exchanger size is specified, to provide a complete package that can be easily installed without need for major stuffing box alteration. Crane Packing Co.

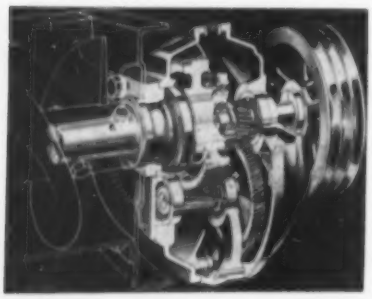
2—VALVES are designed to stand corrosive fluids

Relief valves and back pressure valves are announced for use with corrosive fluid at pressures to 1500 psi and temperatures to 250 F. The topworks of these valves are protected by Kel-F thermoplastic diaphragms. Available in four standard sizes from ¼ to 1 in., these valves offer a wide range of pressure settings which can be made with a screw driver. For high corrosion resistance, valve bodies are of cast steel, 316 stainless steel, Carpenter 20 and Hastelloy C. Specifications are in Bulletin 1255-B. Milton Roy Co.

3—SPEED REDUCER for screw conveyor applications

As its name implies, the Screw-King Drive is a compact speed reduction unit with a flange adaptor to permit bolting directly to the trough end of a screw conveyor. The output shaft fits into the end of the pipe of a standard 6-, 9- or 12-in. screw having a bore of 1 15/16, 2, 2 7/16 in. The input shaft of the unit is driven from any type of motor by a short center V-belt drive.

The unit retains basic design of company's Shaft-King Speed Reducer, but has five additional features built in: a direct drive shaft for the screw conveyor; integral drive shaft support bearings; a double-purpose dust seal; high capacity to absorb screw conveyor thrust loads; unusual compactness. Trough ends, punched with holes to match the bolt holes in the adaptor plates and screw conveyor troughs are also furnished by company. It is pointed out that the Screw-King is bolted directly to the trough end, and eliminates any tendency to wobble. The unit can be used to drive inclined screw conveyors where the angle of inclination or declination is up to 20 deg above or below horizontal. The Screw-King is made in three sizes from 1½ to 10, hp, each size with three reduction ratios as follows: 5 to 1, 13 to 1, and 20 to 1. The American Pulley Co.



4—CONTROL UNIT for under window installations

Model CM is announced as a high velocity unit for use under windows or on any wall surface as a practical means of air distribution where space requirements necessitate high velocity air to be delivered to individual diffusers. The adjustable grille used on the Model CM assures rapid diffusion and draft-free distribution of conditioned air, it is noted, and the front of the cabinet is sloped to prevent the grille from being covered by objects that would prevent proper air distribution. Specification Sheet F-7678 gives technical data on the unit. Barber-Colman Co.

5—SOLVENT aids in reclaiming encapsulated parts

Salvage of defective encapsulated circuits and parts is possible, where plain or cured epoxy or polyester resins are involved, says manufacturer of Monastrip EP. Developed to answer the requirement of a simple soaking application, Monastrip EP is said to involve no labor. Also this solvent is not exhausted, says company, but can be used over and over. Bulletin 600 provides details. Solvent Div., Mona Industries, Inc.

6—HANDWHEEL OPERATOR for cylinder actuators

The Cono-Clutch is available as an integrally mounted accessory for company's standard line of cylinder Conomotor actuators — pneumatically positioned power actuators for throttling control on valves, motor driven speed changers, proportioning pumps, flow regulators, rheostats, autotransformers. This hand operator affords immediate manual control in event of air failure. It is said to be the only operator of its type which can be instantly thrown in and out of gear at any position of stem travel. Clutching and declutching are accomplished simply by pulling or pushing a knob. No special tools such as pins, latching devices and hand cranks are required. It is claimed that when handwheel is in declutch position, there is no interference with full and free stem travel. All gears are enclosed in a sturdy, lightweight aluminum housing to eliminate possibility of dust and grit clogging gear mechanism. Bulletin LB-2 gives further information on the Cono-Clutch. Conoflow Corp.

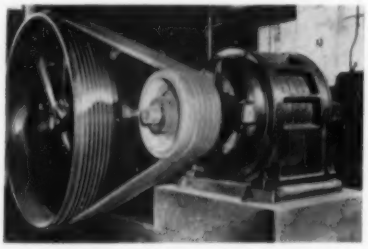
7—LIQUID DETERGENT is general purpose cleaner

Liqui-Det is described as a concentrated liquid detergent containing no soap. It is said to go into solution instantly and to develop copious suds, in hard or soft water, hot or cold, and then to penetrate and loosen common soils in a short time. Furthermore, says company, Liqui-Det can be used repeatedly without rinsing, and without causing build-up of film or discoloration. It is claimed safe on all surfaces and pleasant to the hands. Concentrations as low as ¼ oz to a gallon of water are reported effective. Oakite Products, Inc.

Described on these pages are new and improved products. Use Reader Service Cards on pages 97–98 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

8—V-BELT is high-capacity low maintenance type

For applications where increased power transmission is desired with a minimum of maintenance on multi-V-belt installations, the Powerflex Hi-Capacity V-Belt



comes in standard sizes and has an oil resistant cover to prolong belt life. The Powerflex is claimed to have 40 per cent more strength than many belts and to reduce belt failure to a minimum, and to promote increased bearing life because of lighter weight and lower stresses. This belt can be furnished with static conducting covers. A and B section belts have laminated construction and C, D and E sections are of heavy rayon grommet construction. Thermoid Co.

9—LUBRICANTS resist both acids and alkalies

For problem applications, these acid- and alkali-resistant greases are claimed to provide effective protection against more than 100 corrosive agents and solvents. In addition, these specialized lubricants are reported to prevent leakage, preserve packings, protect equipment and floors, and lower operating and maintenance costs. Known as the 5F

This Crane valve on superheated steam since 1946—with no maintenance

You'll spot cost-saving performance in the record behind this Crane valve—it has been on duty an even decade of years, with no maintenance at all!

Neches Butane Products Company installed this Crane 8-inch, 900-pound Pressure-Seal angle stop-check valve in 1946 in its butadiene plant in Texas. On superheated steam boiler service, this valve has never failed to close tightly and surely—and operate smoothly and easily—with no sticking, no troubles—no need to go near it with a wrench.

There's no question that dependability is a must in service like this. Minimum restriction of steam flow—plus smooth, positive and quick seating on backflow—*must* be provided for safe, steady boiler operation. And Crane stop-check valves can do it—*have* been doing it for years and years.

Before you specify any valve, be sure to look into the advanced designs and materials, the broad selectivity and service suitability of the great Crane line. You'll find everything you need in valves and fittings—built to the highest standards of quality. Get full information from your local Crane Representative, or write to address below.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

For more data circle 524 on Post Card

Line, it includes three types (5P7, 5P8 and 5P9) covering operating temperatures from 0 to 350 F. They have a smooth, non-fibrous body, are pale amber to light cream in color and made in four consistencies (heavy, medium, light and X-light) and have an ASTM penetration range of from 200 to 350.

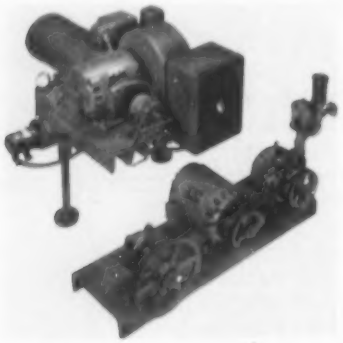
According to manufacturer, these greases provide superior lubrication to plain and anti-friction bearings, driving chains, pump packing glands, and lubricated valves in equipment such as can-closing machines, extractors, pumps, intake water screens, and others. Keystone Lubricating Co.

10—COMPUTING DEVICE for use in pneumatic measurement

The Sorteberg Force Bridge is a computing device designed for use in pneumatic measurement or control circuits for a variety of purposes. Manufacturer says, it can convert a transmitted signal from a square root flow transmitter into a linear signal, permitting use of a flow receiver with an evenly graduated chart; it can be used to maintain a ratio between two pneumatic signals for flow ratio control; and it can also be used to multiply, subtract, divide or square pneumatic outputs, or to provide pressure and temperature compensation for transmitted flow signals. The design of the device assures friction-free operation, company notes, by the use of the feedback principle in a weighbeam and fulcrum system. Principal components are of plug-in construction, housed in a rugged, die-cast case. Minneapolis-Honeywell Regulator Co.

11—OIL BURNER is economical, high efficiency unit

Econol TH-60 and TH-84 Oil Burners are designed to give higher efficiency from low-cost No. 5 fuel. No. 1, 2 and 4 oils may also be burned. A 2,000-w preheater heats oil to burning temperature. Other features are: iris shutter to provide accurate, metered air control,



a built-in viscosity compensator to assure a constant firing rate regardless of oil viscosity, an improved air-oil atomizing nozzle. The Econol also has a low-fire start, to assure safe ignition, without flarebacks. Compressor, fuel-oil pump and motor are located on a separate chassis, which may be installed on a wall or suspended from ceiling. Model TH-60 burns from 5 to 20 gph of oil and has a maximum boiler rating of 60 hp. Model TH-84 burns 7 to 28 gph and has boiler rating of 84 hp. Both models have a 90-gph oil pump. Industrial Div., York-Shipley, Inc.

12—AIR MAGNETIC CONTROL designed for tube expanding

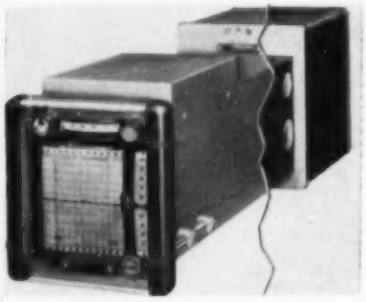
Operation of this air magnetic control is based on a powerful permanent magnet designed to give positive and instantaneous engagement and disengagement between driving mechanism and driven expander. Control is air-driven and described as ideal for rolling tubes in hazardous locations. A single compact unit (weight 10 lb, length 10½ in.), it is well balanced for ease in handling. One of the features announced is a sensitive, easily adjusted calibrating dial that permits exact settings for torque control. It has a positive drive action that stops when pre-set torque is reached. Then, after disengagement of expander, motor runs free, cutting number of required stops and starts in half. An on-off locking switch and separate reversing trigger permit uninterrupted sequence of operation, and a quick-release chuck serves to lock expander securely yet allows snap motion insertion or removal. Control comes in a fitted metal case that holds unit and expanders. It operates on 28 to 30 cfm of air at 90 psig. A single ⅜ in. air hose is the only connection required. Lagonda Div., Elliott Co.

13—pH RECORDER needs no external power supply

Portable, self-contained, pH measuring and recording instruments requiring no external power supply are offered for field surveys of stream pollution, waste-treatment plant effluent, and industrial water supplies, as well as in-plant studies at locations where a permanently mounted pH recorder is not desired for any reason, or where power is not available. The device consists of two units: Model 524 pH recorder and N-2 amplifier. This equipment is designed to cover the total pH range of 0-14 in two partial ranges of 0-8 and 6-14. Selection is by means of a switch located on the amplifier. The recorder uses carbon-coated 8-in. diam charts, and makes a record with a vibrating stylus. Chart drive can be set to rotate the chart in either 1 hr or 24 hr, depending on the application. The two units together weigh less than 50 lb, and are compactly arranged for easy transport. Temperature compensation is by manual adjustment, after reading the temperature of liquid being tested. Various types of electrodes are available, including those suitable for immersion, flow, and laboratory applications. The Bristol Co.

14—INSTRUMENT shows levels in faraway tanks

Called a capacity telemeter, this remote control electronic device can be connected by coaxial cable to a control position as far as 4000 ft — more than ¾ mile — away. Its accuracy, in gaging the contents of a tank, is claimed unaffected by changes in weather conditions or electrical properties of the cable. Developed for chemical and manufacturing plants and refineries having materials stored in tanks and bins scattered over a sizable area, this instrument is also reported economically feasible for some single tank installations, particularly in hard-to-measure situations. The complete capacity telemeter system consists of a measuring unit, a remote probe unit for each tank, and an indicator. Fielden Instrument Div., Robertshaw-Fulton Controls Co.



15—ELECTRONIC CONTROL is instantaneous, plug-in type

This line of unitized controls is designed on company's Autronic principle of instantaneous, all-electronic control. According to manufacturer, Unitizing results in a number of advantages, among which are: controller, recorder (or indicator) and manual control are of plug-in construction; any combination of units is contained within a universal mounting case requiring a single standard panel cutout of only 5 by 5 in.; wiring between individual instruments is eliminated; instruments can be pulled out of panel without employing "jumpers" and without upsetting system balance. Since units are of plug-in type, two or more functions can be combined in a universal mounting case. The Swartwout Co.

16—PVC EDUCTORS for liquid pumping, mixing

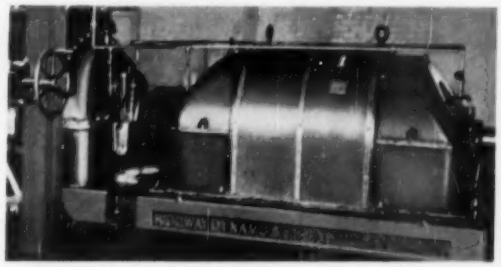
Designed for use in liquid pumping and mixing operations, especially those employing corrosive fluids, these PVC eductors can also be used to handle solids when particle size permits. Polyvinyl chloride offers exceptional resistance against many corrosive media, it is pointed out, in some cases surpassing that of high grade steels and alloys. Materials not to be handled include acetone, ketones, ethers esters, or aromatic or chlorinated hydro-carbons, manufacturer states. The new line comprises six standard sizes from ½ to 3

Another achievement in the long record of

ELLIOTT "FIRSTS"

Elliott's consistent leadership in the manufacture of large two-pole induction motors has kept designs in advance of the power industry's ever-expanding need for larger and larger boiler feed pump drivers. The motor shown above—the largest built to date—is one of three boiler-feed pump drives for a large midwest utility company. It incorporates the features of "super-quiet" design, for which Elliott two-pole induction motors are noted.

The first large two-pole motor built (shown below) was manufactured at Elliott's Ridgway Plant in 1916. The vast amount of experience in two-pole motor design and construction accumulated by Elliott since that time is reflected in superior present designs, and the satisfaction expressed by users.



Send for a copy of our new booklet, "Milestones," which gives more information about these machines. Address Elliott Company, Ridgway, Pennsylvania.

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

R6-24

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in., with performance characteristics similar to those of metal eductors of equivalent size. PVC eductors have maximum ratings of 125 psi, 160 F. Schutte and Koerting Co.

17—POTENTIOMETER records on a 3-in. strip chart

This self-balancing electronic potentiometer gives a continuous record on a 3-in. strip chart, it is announced. The new recorder, which uses standard components, is housed in a case only 5 in. square, to blend with other modern miniature instruments. It is identical in appearance to company's Metagraphic Pneumatic Recorder. Accuracy and sensitivity are reported unchanged from the standard 12-in. instrument.

Small-size self-balancing instruments are furnished in indicating models also. Indicating and recording chassis are both built for plug-in service, and can be interchanged. Offered in either potentiometer or a-c bridge models, the new instruments can be used to measure and indicate or record any variable which can be converted into an electrical quantity, such as temperature, pressure, flow, speed, pH, and smoke density. The Bristol Co.

Reader Service Cards on pages 97–98 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

18—BRAKEMOTORS designed to stop quick, hold heavy loads

These rugged, cast-iron brakemotors stop instantly and hold heavy loads, manufacturer claims, and they afford long, trouble-free service on a wide range of equipment from bottle-washing machinery to heavy-duty cranes. Features announced include a wide torque range from 3 lb-ft to 345 lb-ft, one-piece molded friction linings and one-operation torque setting. In the event of power failure or low voltage, "dead man" operation sets and holds the load until normal operation is restored. A variety of enclosures are available, including those suitable for outdoor installation or where moist, corrosive, or abrasive dust conditions exist. Reliance Electric & Engineering Co.

19—CABINET FAN offers versatility and space savings

Designed for operation at low noise level and space-saving installation in buildings with low ceilings, this large volume unit, the Cabinet Fan, is suggested for industrial and commercial applications. It can be used in air moving systems for supply, exhaust, or recirculation of air, and is available in 12 sizes from 600 to 34,500 cfm, with outlet velocities from 1000 to 2600 fpm. One- and two-fan models are available, with two-fan units mounted side-by-side on a single shaft to maintain a flat, compact cabinet. Bearings, drives and motor are mounted outside the cabinet. Optical equipment for the Cabinet Fan includes filters, mixing box and dampers. Further information is in Bulletin DS-348D. The Trane Co.

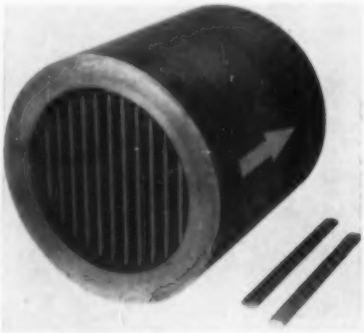
20—TOGGLE SWITCH can control many circuits

According to manufacturer, this rotary toggle switch offers a solution to the problem of controlling many circuits with single-motion, mechanical actuation. The small switch is designed to handle a high electrical load, and it is rugged enough for most industrial applications, company states. The four-pole, double-throw switch (designated 4TRI) is maintained in all three actuation positions: on-off-on. It has 12 terminals, with 24-terminal, 8-pole models available. Switch has operating force of 9 in. lb max. Micro Switch, Div., Minneapolis-Honeywell Regulator Co.

21—ENTRAINMENT SEPARATOR is corrosion-resistant unit

Developed for removal of liquid particles from air and other gases is this impingement type entrainment separator made of company's Karbate, impervious graphite. Called the Type MV Scrubber, it is a compact, self-contained unit ready for insertion in a pipeline. Rods of impervious graphite, streamlined in cross-section, are staggered in rows within the cylinder. It is noted that although minimum clearance is ¼ in. to prevent clogging, a beam of light will not pass through. As the gas to be scrubbed flows through the cylinder, moisture particles impinge on the rods and the gas flows on through.

At a pressure of one atmosphere, the scrubber is designed for gas approach velocity of about 30 ft per second, at which the pressure drop is less than 1 in. (water column). The pressure drop is lower under vacuum conditions. It is explained that at velocities twice those designed for, re-entrainment occurs, but is retarded by the teardrop cross-section of



the separator rods. Impervious graphite materials in the scrubber are chemically inert to mineral acids, organic solvents, salt solutions and other corrosives, company states. The unit can be operated at −40 to 340 F, at pressures from full vacuum to 65 psig. It is available in four internal cylinder diameters from 6 to 16 in. Each cylinder is 22 in. long, is designed for installation between faces of 150-lb ASA flanges with no enlargement of the pipeline required. National Carbon Co., Div., Union Carbide and Carbon Corp.

22—RENTAL SERVICE lets network analyzer work for you

The network analyzer illustrated is available to utilities and manufacturing plants for their use in making power system studies. Fast operation, accuracy and minimized advance preparation recommend this unit for completing complex problem solutions in a short time. Quiet, air-conditioned quarters, designed for the purpose, aid in efficient operation. The analyzer is announced as capable of simulating any electrical system which may be represented by 12 generators, 88 lines, 32 loads, 16 transformers and 150 buses. Company says the nominal per diem rental fee includes services of an operator and an assistant. Location is in downtown section of Philadelphia. I-T-E Circuit Breaker Co.

23—PLASTIC MATERIAL for vacuum line sealing jobs

This plastic gasket material is designed to solve vacuum line sealing problems by forming a protective coating around surfaces. Users report that by adding 1/64 in. film or coating to flange faces and gasket surfaces, vacuum line leakage is reduced to a minimum. It is noted that any slight leakage which may occur after line has been in service for some time can be corrected without dismantling flanges by simply applying 1/32 in. of plastic gasket material around the outside surfaces of the flange where they meet with the gasket. The material is available in two formulations — one for air, steam, water, mild chemicals, the other for gasoline, oil, solvents. Where flange faces are unmarred and come together evenly, material can be used alone without any other type gasketing material. Plastic gasket is described as non-hardening, and the flanges sealed with it as easy to dismantle even after years of service. Flexrock Co.

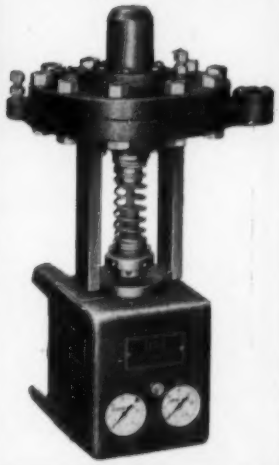
24—FIELD COIL with improved insulation system

An "integrated" field coil with a newly developed insulating system designed to protect electric motors and generators against atmospheric contaminants and destructive mechanical forces is announced. This field coil construction is reported particularly well suited for applications requiring chemical resistance, oil and moisture-proofness, or sealing against atmospheric contaminants such as carbon black, dust and dirt. It is currently available for synchronous and d-c machines subject to severe duty cycling in Class A and B temperature classifications. Studies indicate that the system will eventually be available for Class H temperature applications.

Primary insulation in the "integrated" field coil construction is glass with fibers tailored and oriented for

Here's the *pilot* with the *sense* to save *dollars*

Close Control



Leslie Type LA-2
Level Control Pilot

EXTRACTION TYPE FEEDWATER HEATER DRAIN CONTROL
This Leslie liquid level controller is installed in heater drain service in a Midwest utility station. You will also find Leslie liquid level controllers in condenser hot well service, de-aereating heater installations and boiler level control.

Leslie Floatless Level Control Pilots sense changes in liquid level that will help you maintain peak output. You save maintenance dollars, too — forget troublesome floats and cages (there aren't any).

With low resolution sensitivity (.1 of an inch change in level creates response), you are assured of smooth, throttling action and a closely held level.

There are Leslie Pressure Control and Temperature Pilots with the sense to save dollars in pressure and temperature control stations, too. Your Leslie Engineer, listed under "Valves or Regulators" in your classified directory, will be glad to help you.

Send for Bulletin 5303 on Leslie Control Pilots

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CONTROLLED QUALITY MEANS QUALITY CONTROLS

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OXYGEN

key to modern industrial processes

Control it with...

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OXYGEN ANALYZERS!

Oxygen is one of the most important factors found in modern chemical and industrial processes. Whether to minimize product oxidation (prepared atmospheres, air infiltration, etc.) ... or to insure adequate oxygen for efficient combustion (boilers, kilns, etc.) ... or to control oxygen for proper process operations (ammonia, acetylene, air fractionation, etc.) oxygen control has become too important in today's operations for any profit-minded executive to overlook.

And because they are the *only* instruments that measure oxygen content directly, accurately and conveniently, Arnold O. Beckman Oxygen Analyzers have become the leading instruments for modern oxygen control in a wide range of applications—from catalytic refineries to cement kilns—from power plants to personnel protection.

These instruments (and systems) can be built to meet *your individual* needs.

These instruments offer many unique advantages ...

SELECTIVITY: Highly sensitive to oxygen. Effects of gases other than oxygen are negligible.

HIGH ACCURACY: 1% of full scale (Example: ±0.05% O_2 on range 0-5% O_2).

MANY RANGES: Full scale ranges from 0-1000 ppm or up to 0-100% O_2 available. Combustion ranges 0-5, 0-10, 0-15% O_2 supplied with 0-25% O_2 check range. Multi-range instruments available.

RAPID RESPONSE: Standard Analyzers—95% response in less than 1 minute. Special Units—95% response in 7 seconds!

USE ANY RECORDER: Millivolt output for potentiometers; current output for miniature electronic recorders and galvonometers; air output for pneumatic receivers and control systems.

PACKAGE UNITS: Analyzers and controls may be built into a cubicle with sampling components wired, piped, and ready for installation as a single unit.

SAMPLING SYSTEMS: Complete standard systems—components, package or portable units are available.

OTHER ADVANTAGES: Instruments may be mounted in explosion-proof cases, mounted indoors or outdoors, in portable panels, and have other desired features.

Model F3: Ranges of 0-1%, 0-5%, 0-10%, and higher. Meter on door for convenient readings at sampling point.

Model G2: Full scale ranges 0-0.1%, 0-0.5%, and others for low O_2 content. Ranges 90-100%, 95-100% O_2 for high O_2 content.

The above are but two of the complete line of Arnold O. Beckman Oxygen Analyzers available for every requirement.

Send for helpful free literature which describes Arnold O. Beckman instruments in detail. When writing, outline your particular application—we'll gladly supply specific information.

Data File 20D-17

Arnold O. Beckman INC.

ANALYZERS

Profit Builders for Industry

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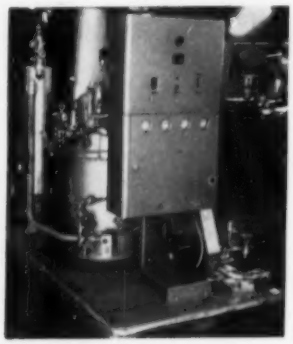
strength. Solventless types of inorganic, heat stable resins augment the glass fibers. According to company, these resins bond so well with coil conductors and pole surfaces that the structure is fused together into one integral part—and the enveloping skin inseparably locked with the coil and pressure molded to coil contours. This construction is claimed to result in dimensional stability, mechanical strength and durability, toughness and resiliency. Full details are given in Leaflet 05R8525. Allis-Chalmers Mfg. Co.

25—GENERATOR is fast steaming, compact unit

Model 4615 Vapor Modulatic is announced as a steam generator with only 99 sq ft of heating surface, which produces 400 to 1750 lb of steam per hour, from 60 F feedwater at 75 to 300 lb steam pressure. It is designed to develop 200 lb steam pressure in 2 min from cold water. Automatic controls cause the generator to cycle on and off and change volume of steam produced to meet a changing demand, it is noted; and a servo-water-bypass control meters fuel, feedwater and combustion air, so that the unit produces steam at about 80 per cent efficiency at all levels of output. Working pressure may be changed by turning one control.

Only 84 in. long, 48 in. wide, and 70 in. high, this unit owes its compactness to



two design features: the pressure atomized fire releases more heat per cubic foot of combustion space; and the 337-ft long steel coil is designed so that hot gases from the fire wipe over and around the coils, transferring heat to the water being pumped through the coils under pressure and turning this water into steam.

Burners are available for No. 2 fuel oil, for natural gas, and for combination oil or gas. Fuel is changed by flipping a switch. Several protective safety controls are built in. The Model 4615 Vapor Modulatic is a complete package with 3-hp electric motor, blower, feedwater pump, steam separator, fuel pump, and controls all mounted on steel base. No special walled-in area is necessary, says manufacturer. Units are ready to operate when service connections are made. Vapor Heating Corp.

26—DIAPHRAGM GAS VALVES are relay operated units

Two recent additions to this company's line of relay-operated diaphragm gas valves will become the firm's basic line-voltage models for commercial and in-

THIS 400,000 Pounds per HOUR

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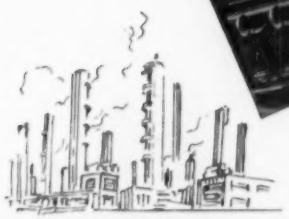
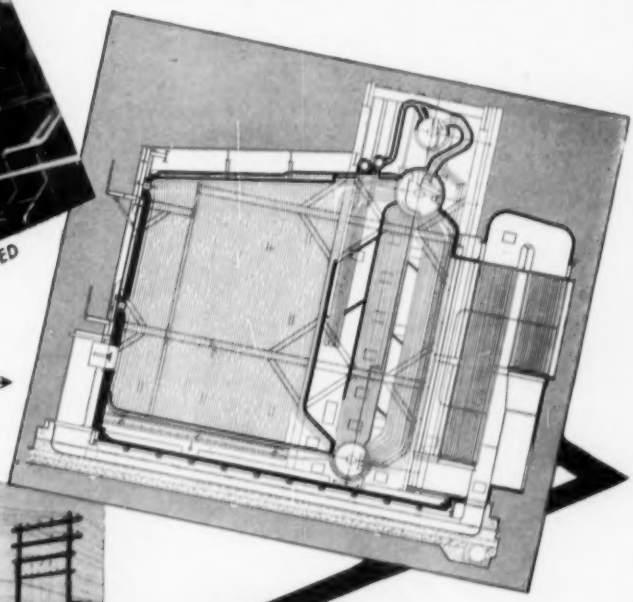
STEAM GENERATOR

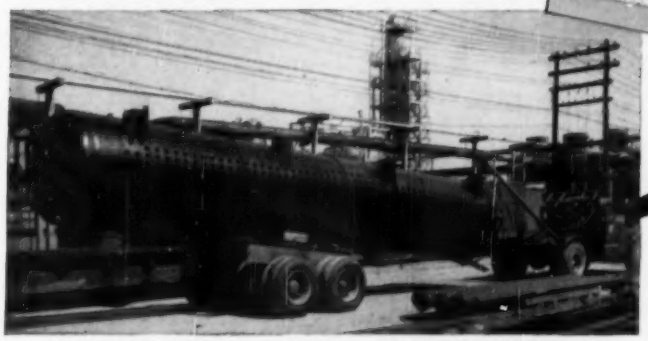
Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT →
LONGITUDINAL SECTION THROUGH THE UNIT.





6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

PRINCIPAL DATA

400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Oil and Acid Sludge fuel.

Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

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given:

—to add nitric acid to liquid isotope at 4500 psi.

—to pulse liquid extraction columns — 4½ gal. per stroke, 100 strokes per min.

—to pump liquid oxygen at minus 340°F.

—to flow-blend inhibitors in high pressure process lines.

—to charge pressurized-water atomic power systems.

—to pump additions of D^2O to new homogeneous reactors.

PHILADELPHIA SERIES HP HIGH PRESSURE PUMPS

. . . are the solution to these and many other process pumping requirements outside the realm of ordinary proportioning pumps.

CATALOG HP-1254 describes these *advanced design* Pumps. They meet an entirely new conception of operating requirements—demanded by modern high pressure processing techniques.

PHILADELPHIA PUMP & MACHINERY COMPANY
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dustrial burners of 5-lb rating. One valve model (V-48F) is furnished with position indicator but without manual opener and is designed for final shut-off service. The other model (V-48G) is a general purpose type and available with manual opener but without position indicator. Both types come in 2-, 2½- and 3-in. sizes and can be used with all gases including LP and high-sulfur-content gas. Compactly designed, the valves are reported to feature quiet operation, large valve actuator porting and increased capacity. They are designed for right- or left-hand installation and use a weight- and spring-loaded diaphragm. Electrical parts are mounted outside the gas stream and terminals are provided for each electrical connection. Minneapolis-Honeywell Regulator Co.

Reader Service Cards on pages 97–98 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

27—LIQUID LEVEL GAGES for high or low installation

Inclined Truscale Remote Reading Liquid Level Gages are introduced for mounting high or low on the instrument panel, or at other points. For high installations the case is built so the cover and

scale incline downward; for low installations the case is built so cover and scale incline upward. It is noted that all Truscale Gages are designed to give instant remote reading of liquid levels with accuracy of ½ to 1 per cent of scale reading; they have a convex face with scale marking directly on the face to give 180 deg visibility. They may be equipped with signal horns, lights and other devices. Bulletin 291 gives details. Jerguson Gage & Valve Co.

28—EMERGENCY LIGHT works during power failure

Because of an automatic charging device, the Model A Exide Lightguard can provide increased protection against lighting failures, says manufacturer. The unit is designed not only to operate automatically during a power failure, but also to prepare itself for the next blackout. Immediately following an emergency discharge, it recharges its

A Record Unmatched In The Industry . . .

In *Every One* of the Nation's "Top Six"* Steam Power Plants, Fly Ash Control is by *Western Precipitation!*

As most power plant executives know, the Federal Power Commission annually "rates" the major steam power plants of the United States to determine their overall thermal efficiency as represented by their heat rate (i.e., BTU of fuel consumed per KWH of generated power).

*The "Top Six" steam plants according to the most recent Federal Power Report are . . . 1. Kyger Creek Plant (Ohio Valley Electric) . . . 2. Clifty Creek Plant (Indiana-Kentucky Electric) . . . 3. Kanawha River Plant (Appalachian Electric Power) . . . 4. St. Clair Plant (Detroit Edison) . . . 5. Muskingum River Plant (Ohio Power) . . . and 6. Tanners Creek Plant (Indiana and Michigan Electric).

We at Western Precipitation Corporation, take great pride in the fact that—in EVERY ONE of these "Top Six" plants—the equipment selected for fly ash control is WESTERN PRECIPITATION equipment.

Could there be any greater testimony to the outstanding superiority and unsurpassed efficiency of Western Precipitation fly ash control equipment?

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
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ROTOJET®

Cleans TUBES and PIPES

ANY SIZE

from ½" to 12" I.D.

STRAIGHT or CURVED

Roto engineers are constantly designing new equipment to meet new conditions and applications for its tube cleaners. If you have a pipe or tube cleaning problem, we will be pleased to place our long specialized experience at your disposal. Write, wire or

Phone HUmboldt 3-0570

Illustrated are a few of the many types and sizes of Rotojet Tube Cleaners driven by air, steam or water. We analyze each application before recommending equipment that best meets the requirement.

ELLIOTT COMPANY - ROTO DIVISION

Tube Cleaner Specialists Since 1910

147 Sussex Avenue, Newark, N. J.

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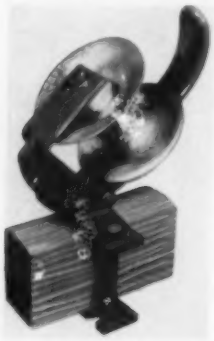
storage battery at a high rate, company explains, and at the end of the high-rate charge, the Lightguard returns the battery to a trickle-rate to maintain itself in a state of constant readiness. A temperature-compensated thermal voltage-sensing relay is provided to eliminate need for a charge-rate switch requiring manual operation.

Requiring addition of water only once or twice a year, the battery of the unit has colored pilot balls which show approximate state of charge. Standard Model A Exide Lightguards have one 25-w sealed beam lamp mounted on the steel case of the self-contained unit. An additional lamp can be mounted on the case, or two additional ones can be connected remotely. Up to three lamps can be powered by the unit. For installation on posts or walls, this unit is available as auxiliary lighting equipment for plug-in connection to 115-v 60-cycle a-c source. Exide Industrial Div., The Electric Storage Battery Co.

29—CROSS ARM SHEAVE for pulling cable around corners

This free-running, generously proportioned sheave is mounted in an easily-attached steel yoke, it is noted, and facilitates installation of aerial cable.



The sheave is adjustable to any angle up to 90 deg, permitting alignment to any angle of pull. It is available in two sizes: one to accommodate cables up to 3-in. diam, and one for cables to 4-in. diam. Aluminum or malleable iron sheaves are available fitted with oiltight bushings. T. J. Cope, Inc.

30—TEMPERATURE CONTROL permits multi-point checking

This multi-point pyrometer controller permits automatic temperature control of 4 to 10 separate units with one instrument, it is announced, combining accuracy of a null balance potentiometer measuring circuit with speed of an electronic control system. Controller applies to almost any installation suitable for two-position control action — including creep test machines, multi-zone ovens and furnaces, batteries of batch process units, others. Advantages reported for this instrument include saving in panel board space, lower initial purchase and maintenance costs, and time-saving convenience of setting and observing temperature controls in one location. Many temperature ranges are available between −400 and 3250 F for standard thermocouple calibrations — and from −100 to 1600 F for resistance bulbs. Thermo Electric Co., Inc.

Unretouched photo showing typical return line corrosive action resulting from carbonic acid and dissolved oxygen in condensate.

BREAKING DOWN WITHIN

This section of pipe looks like new—on the outside. But take a look inside. Grooving action caused by carbonic acid and deep pitting, the result of dissolved oxygen attack, have almost completely penetrated the pipe wall.

Dearborn FILMEEN* prevents such destruction. FILMEEN forms a protective, non-wettable barrier between treated steam, or condensate, and metal pipe surfaces. By preventing the carbonic acid and dissolved oxygen from coming into contact with the metal, FILMEEN assures corrosion-free lines. FILMEEN is only one of many Dearborn water conditioning products scientifically developed to control specific corrosion problems. Others eliminate scale, sludge, carry-over and similar difficulties.

Power engineers in leading industrial and commercial plants place their confidence in Dearborn's 70 years of experience in water chemistry. They have found the answer to the demand for complete plant protection in Dearborn Supervisory Service—a properly balanced water conditioning program which combines quality products with correct, technically supervised control methods and test procedures.

Let a Dearborn Engineer survey your plant and recommend the type of water control program best suited to your requirements.

**FILMEEN is the trade-mark of a corrosion-inhibiting compound patented and produced exclusively by Dearborn Chemical Company. U.S. Pat. No. RE 23614.*

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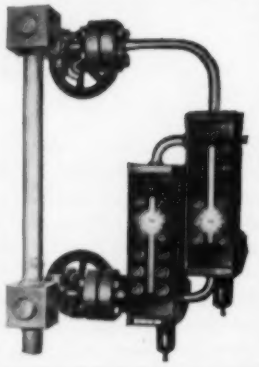

Yarway Flat Glass Water Gage with Type "M" Illuminators. Write for Yarway Bulletin WG-1812.

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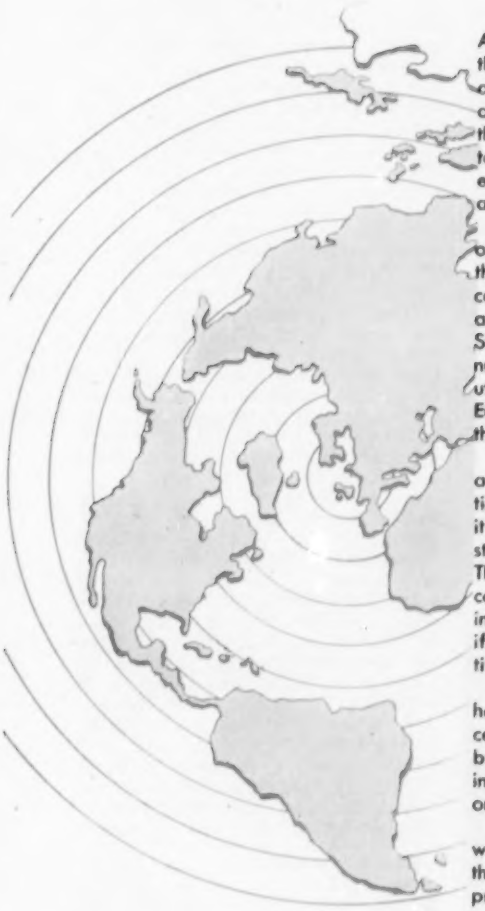
The World's Rising Demand for ENERGY



AT a time when the Middle East is in a state of ferment, when there is unrest in the countries of Eastern Europe, when relations with our own allies are strained as a result of these disturbances, it becomes increasingly clear, to those who are able to penetrate the outward emotional aspects of these troubled times, that these human conflicts have their origin largely in the need for power — power to propel vehicles, and ships, and to generate electricity. In the modern world, energy is the most important resource; all other resources, including food supplies, are dependent upon the amount of energy available.

The troubled situation in the Middle East is due, basically, to the enormous oil reserves centered in that part of the world — reserves which concern us in the United States as much as they concern western European countries. When one considers the fact that a single small Sheikdom — the Sheikdom of Kuwait — not as big as a Texas county, has as much oil as the reserves of the entire United States, it becomes obvious why this region has become so important. Despite nuclear energy, the control of these last of the world's great oil reserves is of the utmost importance to the great world powers — the United States and Western Europe on the one hand, and Russia on the other. The struggle for the control of these oil fields has only begun.

Living standards of nations, today, are dependent upon the amount of power available to those nations. In most countries of the world, there is a direct relationship between the living standards and electricity consumption. For centuries it has been believed — until it became the gospel of millions — that the living standards of peoples depended upon the form of their economic organization. This belief has created a seemingly irreconcilable conflict between believers in collectivism and the adherents of economic individualism. Science, and science inspired technology which in turn means power development, now indicates that if advanced technology is available, differences in economic systems are relatively unimportant, at least as far as industrial productivity is concerned.

We are living in an age of rapid industrial expansion, the tempo of which has never been equaled, and energy may well prove to be the limiting factor to continued development. This has already proved true in many parts of the world but now nuclear power stations offer a new means of making power available in regions where the cost of transport of traditional fuels would be uneconomic or where the utilization of water power is nearing its economic limits.

It is because of this ever growing demand for power throughout the world that we are presenting in this special section a discussion of the national as well as the international aspects of power development in terms of modern technological progress.

Andrew W. Kramer

Editor

Power Engineering Perspectives—

The staggering increase in the demand for electric power throughout the world is hastening the depletion of our fossil fuel resources to a point where they will soon be unable to meet the rising demand for energy. Petroleum production will be far behind demand by 1965. More rapid nuclear power development, vital

By ANDREW W. KRAMER
Editor, POWER ENGINEERING

LAST YEAR, it can be estimated, the world's energy consumption was equivalent to 25 trillion kwh, with all fuels converted to their full potential value. This amount of power is roughly equivalent to the use of 10 tons of coal for every man, woman, and child of the world's present population. By 1975, it is estimated, the demand for power will be some 3 times this amount, and for the year 2000 — only 43 years from now — the demand will be 8 times as much.

Two big power conferences in Europe last summer, the CIGRE Meeting in Paris, and the Fifth World Power Conference in Vienna, made one fact increasingly clear, and it was this: the Earth's finite reserves of petroleum, natural gas, and coal, will not be able to continue to supply much longer the rising demand for energy. The development of new sources of energy must now have the highest priority.

In the U. S. petroleum production will begin to decline in 10 or 15 years, and in the rest of the world not very long afterward. According to Eugene Ayres, the world's annual petroleum production will have fallen far behind the demand by 1965, and, as he says, no conceivable new find could long postpone that evil day. Natural gas, also will probably begin to decline in production by 1970.

Oil shales and tar sands cannot possibly yield more than a brief supply of oil and the problems involved in their conversion are difficult and expensive. Nor will our coal reserves be of much comfort any distance in the future. By 1970, the bituminous beds of the eastern U. S. will be so depleted that we will either have to pay higher costs or find ways of using coals of poorer quality. In other words, all the signs indicate that we are within sight of the end of the fossil fuel era on our planet.

Vienna Meeting Marked New Era

The World Power Conference at Vienna devoted considerable attention to this question of available energy and fuel reserves; it surveyed the energy economy of most of the major nations and it came at a time when there seemed to be a general awakening to the importance of energy as an essential factor in determining the industrial development of each country and its standard of living. The pattern of energy economics of different countries varies widely owing to the diversity of their energy resources and the extent to which they have been developed, but all countries reflect the same avid interest and recognition of the importance of our energy resources.

The meeting at Vienna marked the beginning of a new era, when the possibilities of nuclear power have multiplied the energy resources of the world many times. This has happened at a most opportune time, a time when, without this new source, the energy prospects of the future would be looking rather gloomy. Nuclear power will, in time, relieve the pressure on the fossil fuels but with the almost exponential rise in the demand for energy, every source will be needed in the future to satisfy the wide range of purposes for which energy is needed in the modern world.

So far, water power has not been mentioned in this discussion of energy resources. In certain countries, water power is capable of tremendous development, Russia for example, but contrary to general opinion, several countries traditionally associated with great hydroelectric development are dangerously close to the time when their potential water resources will be exhausted. In Switzerland, assuming that annual water power requirements will increase by only 5 per cent, all the potential water power will be utilized in the next 15 or 20 years.

Sweden's hydroelectric potential is only about ⅓ developed, but the total power available varies considerably in different parts of the country. In the more densely populated southern districts the sources of water power have been almost fully exploited. In southernmost Sweden only a few falls remain unutilized, most of which are small and relatively expensive to develop. It is principally from these districts that new demands for energy must be met. Already 9000 million kwh are trans-

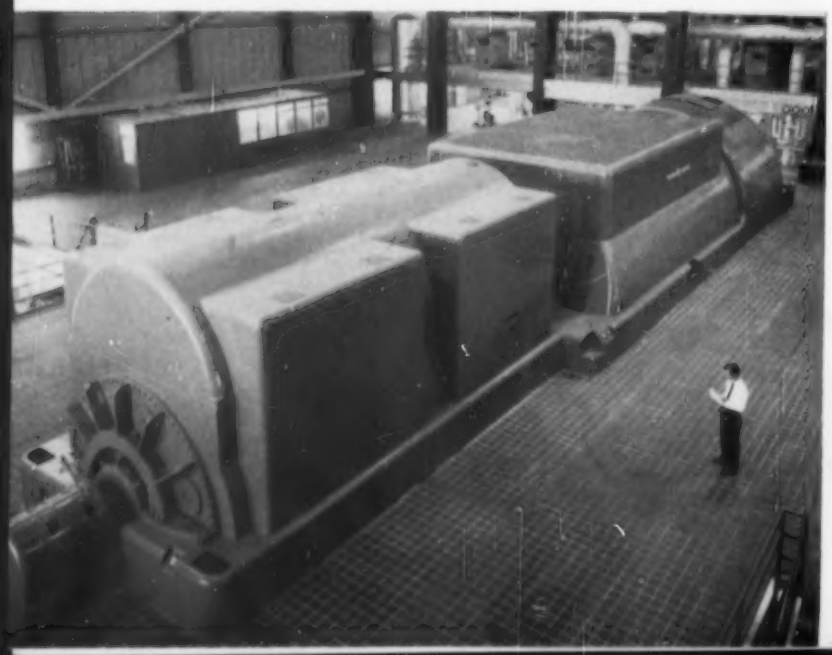
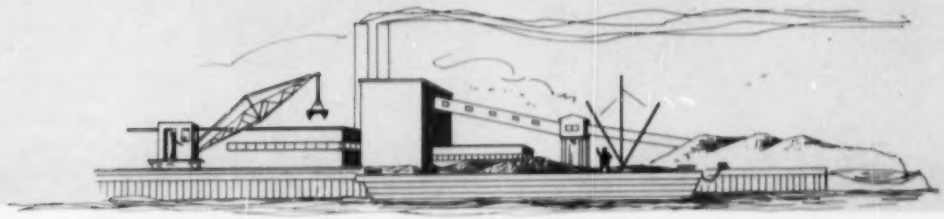


Fig. 1. View of the new 260,000 kva generating unit in Eastlake Station of The Cleveland Electric Illuminating Co. This is the first large steam turbine-generator to use liquid cooling of the stator conductors. This method of cooling enables this machine to produce 75 per cent more power than a conventional generator of similar dimensions

—National and International



mitted from the Northland to central and southern Sweden annually, indeed, the transmission distances are among the longest in the world. These long distances have stimulated the development of some of the highest transmission voltages in the world.

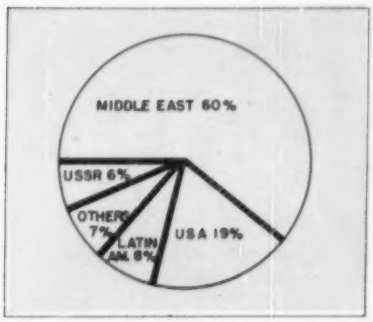


Fig. 2. This is how the world's petroleum reserves are divided at latest report

Hydroelectric power resources in France and Italy are well developed and many of the plants are seasonal in character. Austria has considerable hydroelectric power development under way and Yugoslavia has considerable undeveloped water power which is being developed as rapidly as possible.

Russia has tremendous water power resources and with only about 2 per cent of it developed, they have mapped out an extremely ambitious plan for future hydroelectric development. One of the interesting facts that I learned on my visit to Russia last summer was that Lenin understood the vital significance of power development in the very early days of the Soviet Union. In the Museum of Moscow, visitors can see Lenin's own hand-written manuscripts outlining in some detail the vast system of hydroelectric power plants now being constructed in Russia. Indeed, from everything we saw in Russia, and from all our discussions with Soviet engineers in Russia, at the CIGRE High Tension Electrical Congress in Paris, and at the World Power Conference in Vienna, we were impressed with the magnitude and scope of Russia's vast power plans.

World Power Growth

Forecasts for future developments in power demand are divergent. The estimated annual increases for 1955 over 1954 (the latest world statistics) vary between 5 per cent and nearly 26 per cent. On the average, however, increases in consumption are expected to lie between 7 and 10 per cent, so that for the near future an annual minimum *increase of 7 per cent can be assumed as a basis for the entire world.*

Given the electric power consumption of the world, totalling 1345 billion kwh in 1954, and assuming a 7 per cent cumulative annual increase, the 1958 demand will amount to 1800 billion kwh, which is 455 billion kwh more than in 1954. The problems arising from this enormous increase in load are recognized by all countries, and large-scale investigations into the possibilities of economic water power development and of exploiting mineral resources are being intensified.

Countries which are incapable of equalizing annual water power supplies by electrical interconnection must resort to the construction of big storage plants if deficient in other exploitable sources of energy. A desire for independence of imported fuel for the production of electricity has led to the construction of excessively large storage plants. Pumped storage has gained increasingly in importance to equalize both daily and seasonal fluctuations in demand.

Projects for the joint utilization of border rivers where frontiers run either along or across the river, and the associated trend towards international electrical transmission systems have either materialized, or are under study and planned. Schemes for the exchange of electric power across straits are operating between Denmark and Sweden, and between Calabria (Italian mainland) and Sicily, and an under channel transmission line is planned between Britain and France.

The electrical transmission art has reached a high stage of development in Europe, and American scientists and engineers charged with the responsibility for doubling and redoubling electrical supply systems in this country are finding Europe a rich source of ideas that stimulate and inspire their traditional Yankee ingenuity. European scientists, under the great pressures induced by postwar recovery, are striking out in many directions to develop electrical systems capable of supplying resurgent industry.

Europe, for example, has led the U. S. in the development and use of bundled conductors. Bundling is being used on all 380-kv lines, 2 per phase being used in France, England and Sweden, and three in Russia. In Sweden, a 3rd conductor is being added in some instances to the pres-

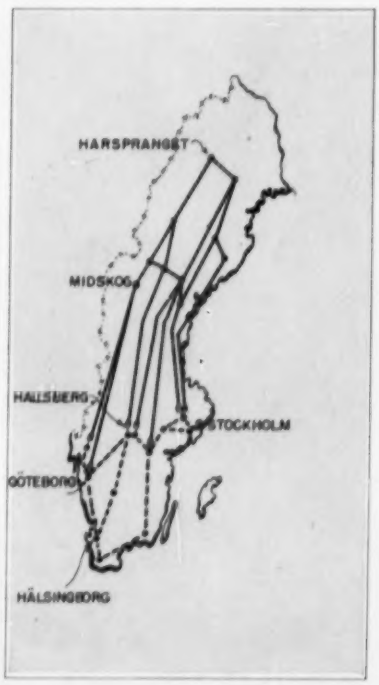


Fig. 3. Sweden's hydroelectric power resources are only 30 per cent developed but most of the sites are in the north while load centers are in south

Fig. 4. Photograph of an exhibit at the Polytechnical Museum in Moscow showing original hand-written manuscripts of Lenin, outlining future power development in the Soviet Union. Lenin understood the vital significance of power in future economic structure of Russia

ent two conductor bundle arrangement. In Germany four conductor bundled lines are being constructed. In several countries bundled conductors are used on transmission lines as low as 110 kv, largely to increase line capacity. On extra high-voltage lines, bundling reduces line reactance and, of great importance in populated areas, it reduces radio interference.

Across National Boundaries

Despite national boundaries it is encouraging to find that most of the Western European countries are served by a well developed high voltage interconnected grid. In some instances considerable power flows across international boundaries; in others the actual power interchange is small but the interconnections are available for emergency. The power grid of Austria is connected with the grids of Germany, Belgium, and France. Yugoslavia interchanges current with Italy and Austria. Holland's 220-kv system is connected with Germany, Belgium, and France. Thus, the whole of central Western Europe is interconnected.

This interconnection of electrical systems between European countries shows how technology tends to override national and political boundaries. Another aspect of this trend is the European Coal and Steel community, composed of six member nations — West Germany, France, Italy, Belgium, Holland, and Luxemburg. Within the framework of this organization also lies the possibility of a free-trade area for Western Europe, with Britain attached to the common market via a free trade zone. Under this plan the six countries propose, gradually, to abolish all tariffs between them.

Leaders of Europe's big three — Britain, West Germany, and France — are convinced that Europe cannot survive if it stays divided into small sovereign states but if Europe had a mass market of 250 million people and some federal institutions, they think it might be able to hold its own in the world. The free interchange of electric power would be a necessary factor in bringing about this state of unity. Another key piece in the new framework of European unity that is taking shape in Euratom, the proposed nuclear energy pool.

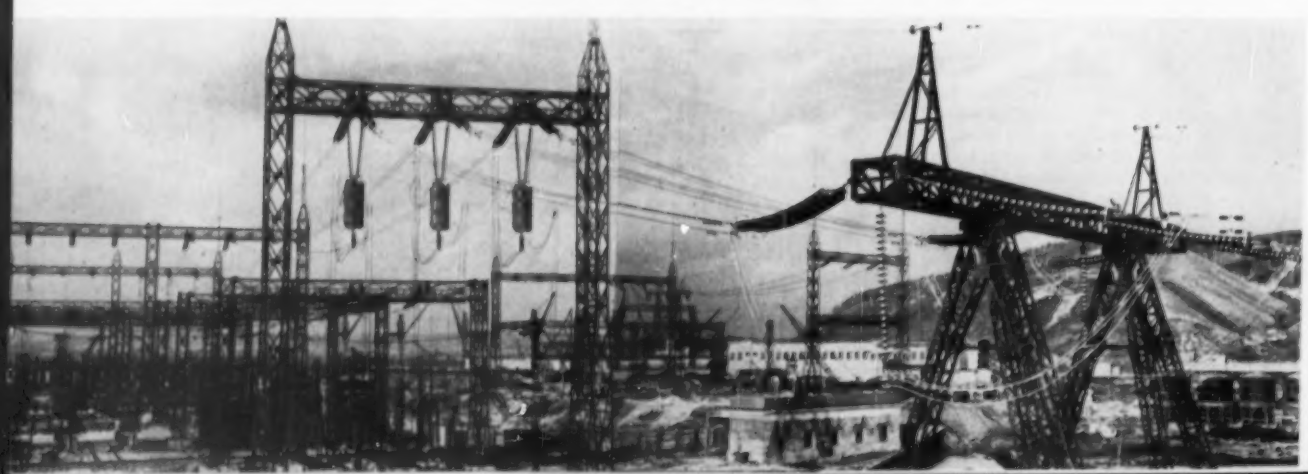
Considering Europe as a whole, the development of water power resources will be virtually completed in 20 to 30 years. Fuel requirements for thermal plants, however, will be doubled within the next 10 years, and as far as forecasts are possible, additional demand for electrical energy in Europe in the future will have to be met exclusively by thermal plants, supplied either from coal or nuclear energy. While generating units in Europe have not reached the capacities being used in the U. S. there is a steady trend towards the construction of larger units.

Europe's largest generating unit, a 150-Mw turbo-alternator set, supplied by Brown Boveri, has recently been installed in the power station at Wiesweiller, near Aachen in Western Germany. Units of 200-Mw are under construction in Europe but, so far, no need has prevailed for units of larger capacity, such as are currently being built here.

In the U. S. we are building single shaft machines of over 260-Mw capacity, and we have 450-Mw cross compound units under construction or on order. The second 450-Mw generator — the largest in the world — is slated for installation in the Philip Sporn station of the American Gas & Electric Co and is scheduled to go into operation in 1959.

Upon completion of the new unit, the Sporn plant will have a capability of 1,050,000 kw, making the station one of three in the world to have capacities in excess of 1,000,000 kw. Like the Sporn station, the other two are also located on the Ohio River. They are the 1,290,000-kw Clifty Creek plant at Madison, Ind.,

Fig. 5. A view of the switch yard and transmission towers of the 400-kv Kuibishev-Moscow line. This is one of the highest voltage transmission lines in the world in actual operation. Note bundled conductors and details of towers and insulators



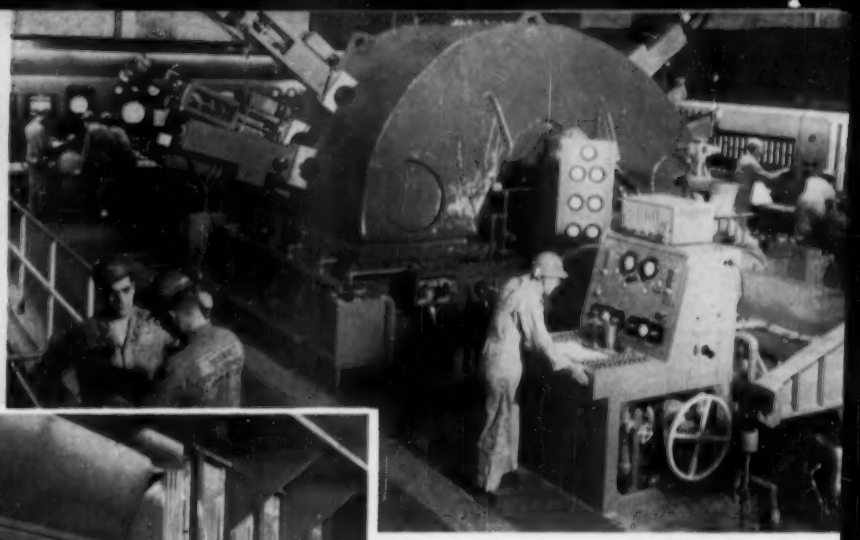
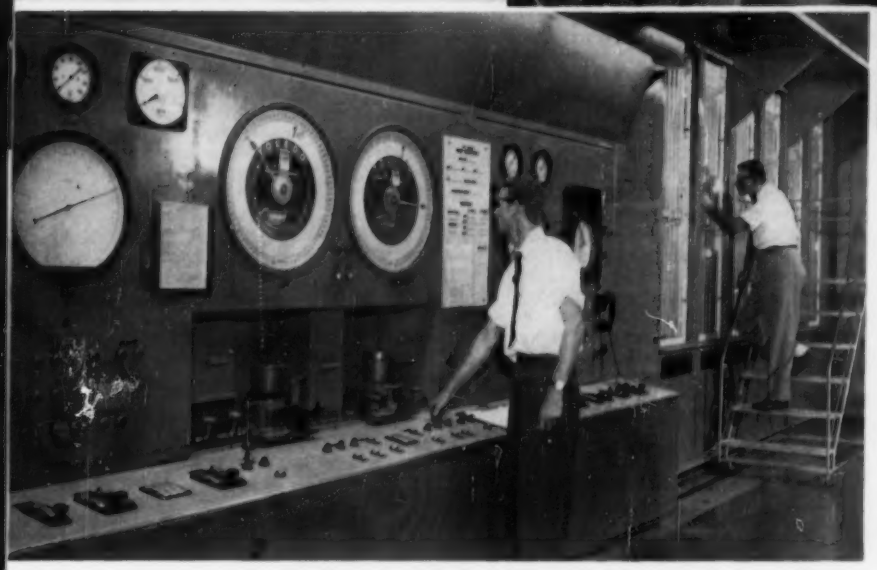


Fig. 6. (Right) This view in the Turbine-generator Development Laboratory of the General Electric Co shows the exhaust section of large turbine on test

Fig. 7. (Below) Here is shown a portion of the instrument panels used in connection with the turbine test shown in Fig. 6. Note banks of multiple manometers at the right used in accurately measuring pressures at all strategic points in unit



and the 1,075,000-kw Kyger Creek plant at Cheshire, Ohio.

Russian Power Development

Thermal generating station design in Russia is progressing towards the same ends as ours in the U. S., that is, towards the use of higher steam pressures and temperatures. High capacity steam boilers operating at pressures of 2420 to 2560 psi are already in operation, and an experimental full-size supercritical steam boiler for a pressure of 4720 psi has been operating in the Soviet Union for several years. This boiler is of the Ramsin once-through type manufactured at the Podolsky Machine Works. This, however, is a small unit with a steam generating capacity of only 48,000 lb per hr. So far as we could learn while in Russia or from the material presented at the World Power Conference, no large supercritical steam plants are under construction in the Soviet Union at the present time. Russian steam plants are not nearly as well engineered nor as efficient as ours.

While electric production is increasing throughout the entire world, the U. S. is still far ahead of all other countries. We produce about 40 per cent of the world's electric power. Russia comes next with 11 per cent. The Russians, however, are making great strides in their power development despite severe setbacks. As a result of the German invasion during the war some five million kw of generating capacity was destroyed or damaged, equivalent to almost 20 billion kwh output. Just before the war, the annual output was 48.3 billion kwh. After the war reconstruction went ahead so rapidly that by 1945 the output was back to 43.5 billion kwh. Ten years later, in 1955, the electrical output was 170 billion kwh, a nearly four-fold increase. This rate exceeds our own; in the U. S. the electric power output has only doubled in that time.

Some of the hydroelectric power developments planned by the Russians border on the fantastic. At least two stations, one on the Angara, and the other on the Enysei River will each have capacities of 3,200,000 kw. Both of these are scheduled for completion during the sixth 5-year plan (1955–1960).

No discussion of world power development would be complete this year without mention of the opening of Calder Hall nuclear power station in England on October 17. This, by all odds, must be regarded as the most outstanding event in the power field during the year, because it ushered in the new era of *nuclear power*. The opening of this great plant some 12 months ahead of the first U. S. nuclear power plant represents initiative and determination of a high order, not to mention skill and technical knowledge. To view this achievement properly, it should be remembered that Britain had made practically no progress along these lines until 1950. It was then that the U. S. withdrew its coöperation on grounds of security, which evidently sparked Britain into effort.

Calder Hall is merely the beginning of Great Britain's vast, fast-moving nuclear project which in 10 years will place her far ahead of all other nations in the world in nuclear power development. Nineteen months ago Britain published a formal *white paper* outlining atomic energy plans for the next decade. This has now become entirely out-of-date. This document forecast the output of 1,500,000 to 2,000,000 kw of electricity from all British nuclear plants in 10 years. From talks with British engineers and from recent announcements it now appears that this figure needs to be tripled, and top officials predict that by 1965 nuclear power will be cheaper than coal.

The British program, born of necessity because of the fuel crisis, has captured the imagination of the world, while we in our opulence have lagged behind in the practical application of nuclear energy for power generation. It will be another year before our first power station is expected to be completed.

Because of our abundant coal reserves, there does not appear to be the same pressing need for power reactors that there is in other countries. This complacent view may be deceptive. At the rate that our electric power demand is increasing, our fossil fuel reserves will diminish at a far greater rate than we realize and when we look at the tremendous job that has to be done, it should become clear that we do not have too much time to meet the staggering demand for electric power.

NUCLEAR POWER Development

The United States leads in overall activity but lags in the construction of commercial nuclear power plants. England's atomic program has no precedent in British industrial history. Formation of Euratom will make central Europe an independent first-rank power in the nuclear energy industry. Russia has ambitious program

INTEREST and activity in the development of nuclear energy continued at an increasing rate in all the industrial nations of the world during 1956. In the United States the atomic industry accounted for sales totaling some two billion dollars and in Great Britain also the commercial value of products sold in this field begins to contribute significantly to the overall economy of the nation. As mentioned in another article in this issue, the opening of Calder Hall nuclear power station in England, on October 17 must be regarded as the outstanding event in the power field during the year.

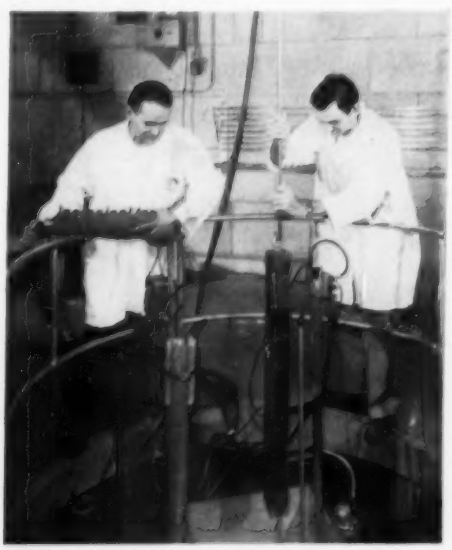
In evaluating the relative progress in England in the nuclear power field as compared with that in the U. S. allowance must be made for the fact that the fuel situation in Britain is much more critical than it is in this country. It imposes a degree of urgency in the development of atomic power there, that does not exist here. On this side of the Atlantic we are inclined to feel that we still have ample coal and oil reserves and that we can be more deliberate in developing an atomic power industry.

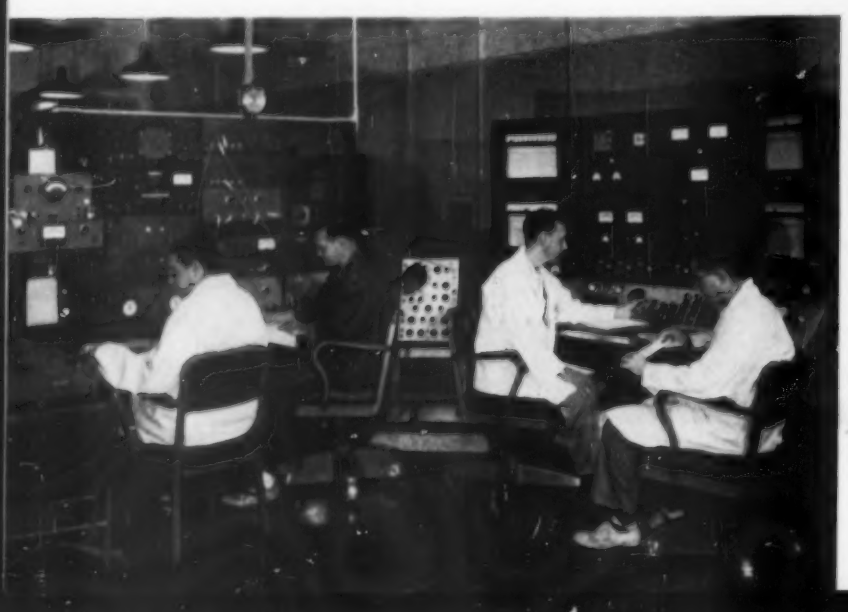
The policy of the U. S. Atomic Energy Commission is to try out various reactor designs during the next 5 years so that when it becomes expedient for us to build atomic power plants we will have a number of tested designs to choose from. This policy led the AEC, several years ago, to create the Power Demonstration Reactor Program involving the construction of five different types of nuclear power reactors. Shippingport Station of the Duquesne Light Co, the first large atomic power station in the U. S. which will be completed toward the latter part of 1957, was built under this program.

To stimulate development of small and medium size atomic power reactors, the AEC, last year, instituted the second round in its Power Demonstration Development Program by asking for proposals to develop and construct power reactors in ranges running from 5000 kw to a maximum of 40,000 kw of electricity. Seven organizations made proposals for building small-scale reactors under this program, 4 of which were approved by the AEC by the end of the year. These are as follows: Rural Coöperative association which plans a 22,000-kw boiling water reactor at Elk River, Minn.; Wolverine Electric Coöperative, planning a 10,000-kw homogeneous reactor at Hersey, Mich.; Chugach Electric Association jointly with Nuclear Development Corp of America, involving a 10,000-kw sodium-cooled, heavy water moderated reactor at Anchorage, Alaska; and the City of Piqua, Ohio, which plans a 12,500-kw organic moderated reactor power plant.

The other of the 7 applications were still waiting approval at the end of the year, one of the most interesting being that of the City of Holyoke, Mass., which proposes to build a 15,000-kw gas-cooled reactor to operate a gas turbine. Gas-cooled reactors that use the heated gas to drive gas turbines are considered as a possible answer to the problem of economic power reactors of small size, and the Holyoke project will be watched with great interest.

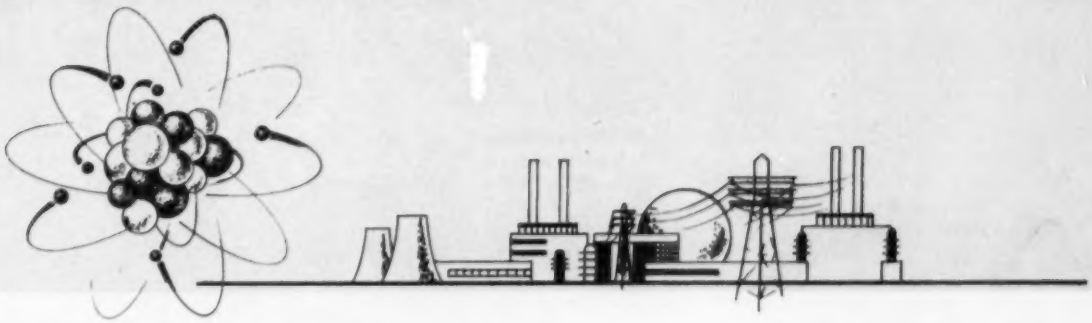
Construction of the Shippingport nuclear power plant near Pittsburgh progressed throughout the year and a number of the components were being installed at the year's end, among them the 230-ton, 33-ft-high





Figs. 1 and 2. A new experimental nuclear reactor of revolutionary design, known as a slow-fast reactor has been placed in operation at Argonne National Lab. At the left is shown the control room of this reactor (ZPR-V). Above is a view showing a fuel element being lowered into the *fast* region of the reactor. This reactor operates at zero power, the fast section being dependent upon neutrons generated in the slow section of unit

Forges Ahead the World Over



reactor vessel which is one of the major pieces of equipment. The construction of this 8½-in. thick steel vessel, made with the precision of a watch, was one of the most difficult fabrication jobs ever undertaken. The vessel was built at Combustion Engineering Co's new nuclear power facilities at Chattanooga, Tenn. Two of the Foster Wheeler primary heat exchangers for Shippingport had also arrived on the site early in the fall.

In the meantime, work on the *design* of three other large nuclear power stations has been progressing. These are, respectively, the 180,000-kw boiling water reactor at Dresden Station of the Commonwealth Edison Co near Chicago, the 140,000-kw pressurized water plant of Consolidated Edison Co at Indian Point, N. Y., and the fast breeder reactor of the Detroit Edison Co (Power Reactor Development Corp).

Construction on the Commonwealth Edison plant is expected to begin in the spring of 1957 but the 5000-kw prototype boiling water plant built by the AEC at Argonne National Laboratory was expected to go into operation early in 1957. The construction of the Detroit Edison fast breeder, however, has hit a snag as a result of the challenge by 3 labor unions concerning the safety of locating the fast breeder at the Lagoona Beach site near Detroit. The union charges are based on a June Report to AEC by its Advisory Committee on Reactor Safeguards, stating "that there is insufficient information available at this time to give assurance that the PRDC reactor can be operated at this site without hazard." As a consequence, the unions have petitioned the AEC for public hearings on the case, and this petition has now been granted. The precedent-setting administrative hearing was set to open on December 10 in Washington.

This fuss over the fast breeder, together with other controversial matters is expected to stimulate a drive in the next Congress to reorganize the Atomic Energy Commission. The change would call for a clearer separation of the licensing and regulatory functions from the operational activities of the AEC than is provided in the present set-up. There was considerable resentment and criticism on the part of Clinton Anderson, Chairman of the Joint Congressional Committee and Rep. Chet Holifield at the AEC's refusal, at first, to reveal the details of a safety report on the proposed fast breeder reactor.

There are other areas of strife between Congress and the AEC. The Gore Bill which would have had the government build six reactors to "demonstrate the practical value of utilization facilities for industrial and commercial purposes" was defeated in the last Congress but it is bound to come up again in the next. Senator Gore maintains that our present program of nuclear power development is inadequate; that it is being delayed by *roadblocks;* that the U. S. is losing the atomic power race to the Soviet Union and Britain. Gore implies that the Electric Utilities are not pushing nuclear power fast enough and that the government should step in and build large commercial reactors.

While the Gore Bill was defeated, the issue is far from dead, and at the Atomic Industrial Forum annual meeting in Chicago last September, Rep. Melvin Price issued a warning to industry on blind opposition to the Gore Bill. He pointed out that both the proposed indemnity program and the Government reactor acceleration program would be brought up early in the next Congress. This warning had its effect upon the electric utility people in the organization of a task force for technical appraisal of nuclear power development by the private electric power industry through the Edison Electric Institute. Primary objective of this task force is to accelerate nuclear power development.

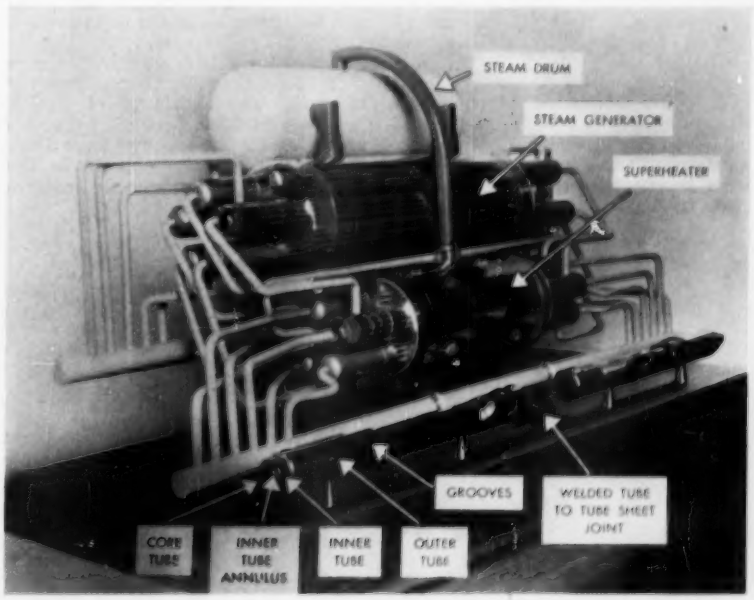


Fig. 3. This is the sort of complexity we get into in the design of heat exchangers for nuclear power plants. This shows a model of a liquid-metal heated steam generator designed by Griscom-Russell Co. It incorporates numerous safety features for the prevention of leaks and the monitoring of leakage

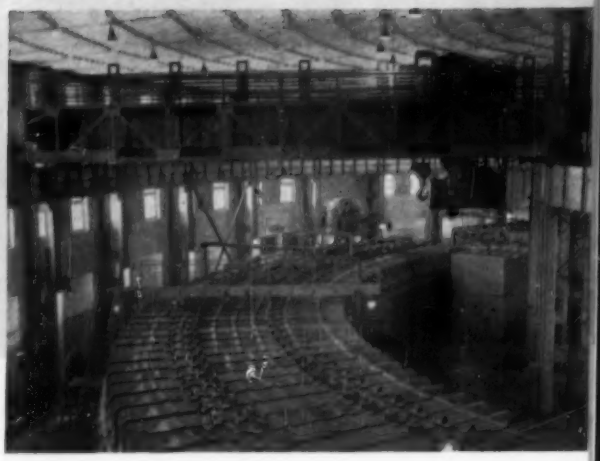


Fig. 4. Here is a partial view of the huge ten billion electron-volt synchroproton accelerator at the big research establishment of the USSR Academy of Science at Ivankovo, 80 miles north of Moscow. This is the largest unit of its kind in the world. The magnetic structure of this unit has a diameter of 200 ft

While politics is involved in this controversy, there is nevertheless need for greater speed in this country in the construction of actual nuclear power plants because of the almost explosive rise in the demand for power which we can expect during the remaining years of this century — there are not too many, only 43. True, we still have tremendous fossil fuel resources and it is also true that discoveries of new petroleum, coal and natural gas fields have been extensive during the past 25 years.

New exploration methods and mining techniques have combined to increase both the supply and the amount of proven reserves of fossil fuels. This has led many to believe, most unwisely, that the limit to conventional fuel resources is so remote as to be no cause for concern to this and the next few generations. A realistic appraisal of the world's energy resources, however, will show that this kind of thinking is not only contrary to the truth but dangerous.

As pointed out in other pages of this section, by 1975 or 1980, the United States — one of the World's leading producers of conventional fuels — will have to begin to rely on nuclear energy for a sizable part of its power needs. A significant index of the degree of American concern with the imminent energy shortage is the prediction that by the *early 1960's all major U. S. Naval vessels authorized for construction will be propelled by nuclear power.*

Atomic Power in Other Countries

Interest in the development of atomic power in other countries is more vital than it is in the U. S. because of the greater lack of conventional fuel resources. In Great Britain, the scope and intensity of the atomic power program has no precedent in British industrial history. The completion of Calder Hall station, the world's first large atomic power plant, in 3 years was a magnificent feat which should compel the admiration of the entire world.

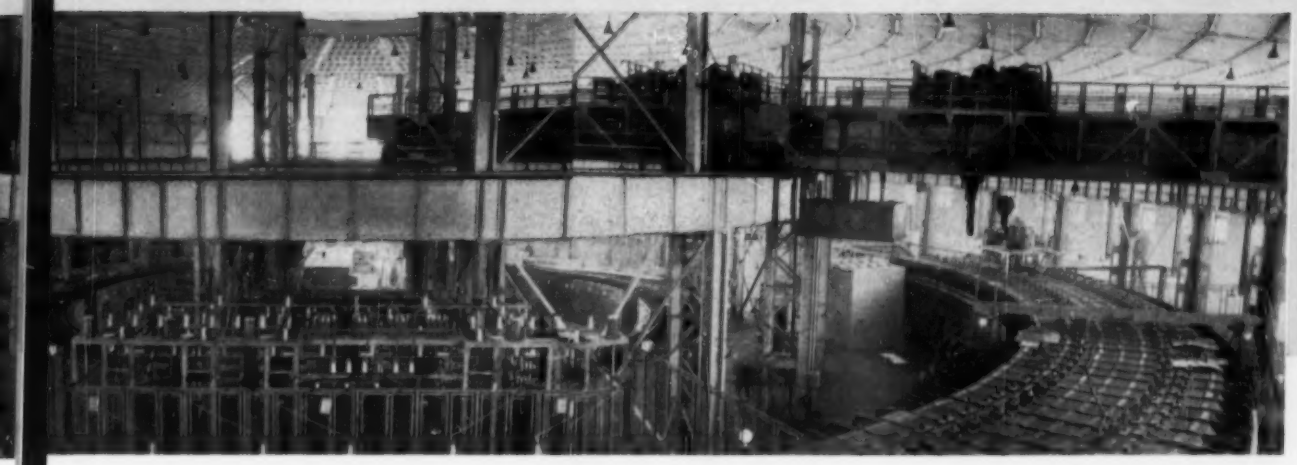
Calder Hall, however, is only the first of at least 12 such, or much larger, stations which Britain plans to build during the next 10 years. Work on several of these stations is going ahead full speed and the design departments of many British manufacturing firms have worked around the clock seven days a week during the entire year.

Since the British atomic program was first announced, the capacity of the Calder Hall type of station has been doubled. Operating temperatures and gas pressures have been raised. Of great importance in the English program is the rapid progress in the construction of Dounreay Station in the north of Scotland, incorporating a sodium-cooled fast breeder reactor of 60,000 kw electrical capacity. A full-scale prototype of this fast breeder is now running at zero energy.

President Eisenhower's offer to make available to other countries enriched nuclear fuels, has been accepted by a number of foreign countries, and bilateral agreements have been made with some 37 different nations. Of these agreements, 31 are research agreements providing for fuel for research reactors and for exchange of unclassified information. Significant progress in atomic development is being made abroad and all European countries are actively engaged in various projects ranging from the installation of research reactors and accelerators to the starting up of atomic power plants.

An important development is the formation of *Euratom*, a Western European atomic pool that will make the 6 coal-steel pool countries an independent first-rank power in peaceful nuclear energy industry. Euratom's first main task will be the promotion — perhaps even eventual ownership — of a number of common installations. Among them, the highest priority is assigned to a U-235 separation plant. Important in this connection is the reported discovery in Germany of a relatively cheap way of separating uranium isotopes. German industrialists think that the new method may cut costs by ¾. During the year France became the second country, after Russia, to have a nuclear power plant in operation when her G-1 reactor at Marcoule went into operation. This is a dual-purpose plant which will produce 33 pounds of plutonium a year and, at

Fig. 5. A general view of Great Britain's Calder Hall Station which was opened by Her Majesty Queen Elizabeth on October 17. It is the world's first large nuclear power station and the plant was constructed in record time



the same time, generate 40,000 kw of electricity.

Like Britain, France may go to liquid-sodium-cooled reactors for her second-stage power reactors. The French have been doing considerable work on beryllium, and report getting reactor grade BeO at 2.95 density, higher than is available in the U. S. Sweden has plans for 4 power reactors, the first, R3a, will deliver 90,000 kw of heat to a power plant by 1960. East Germany will build her first nuclear power plant near Neubrandenburg in Mecklenburg 65 miles due north of Berlin. It is scheduled for operation in 1960. Russia has ambitious plans for atomic power development and is scheduled to build 10 different types of reactors in the current 5-year plan.

A notable event of the year was the address of the Soviet scientist, Kurchatov, at the British Atomic Energy Establishment at Harwell, on the Russian experiments on controlled thermonuclear processes — the so-called fusion process for developing power from the fusion of light element nuclei. He detailed Russian experience as no other government has. The development of the fusion process is of the utmost importance to the world because if it can be attained it would insure an adequate supply of energy for all time to come. Both the U. S. and Britain are working in this field but neither country has divulged information concerning progress or the lack of it. Recently the new $500,000 laboratory built for Project Matterhorn (the Princeton group of the Project Sherwood fusion power effort) was completed. The project is growing so rapidly that the staff is already able to utilize all the facilities.

Russia was the host to scientists from countries all over the world upon the occasion of the International Conference on High Energy Physics, held in Moscow early last May. This was a high level meeting, attended by 200, including 4 American physicists. At this meeting it became obvious that the Russian physicists were equal to the best physicists of the west in this field. The character of the papers and the discussions was the same as in any other specialized scientific conference. Never was there any feeling of tension or rivalry between representatives of different nations. The delegates were shown the 2 large accelerators, first, the 680-Mev proton synchrocyclotron, and later the 10 Bev bevatron. Everybody was impressed by the excellent layout of the laboratories but particularly with the high quality of the instrumentation and the lavish and expensive way in which everything was equipped.

Fig. 6. Erection of test tank for refueling procedures in nuclear power reactors. This is part of the new Atomic Power Equipment Department of General Electric Co and is designed specifically for development work on 180,000-kw Dresden Station, near Chicago

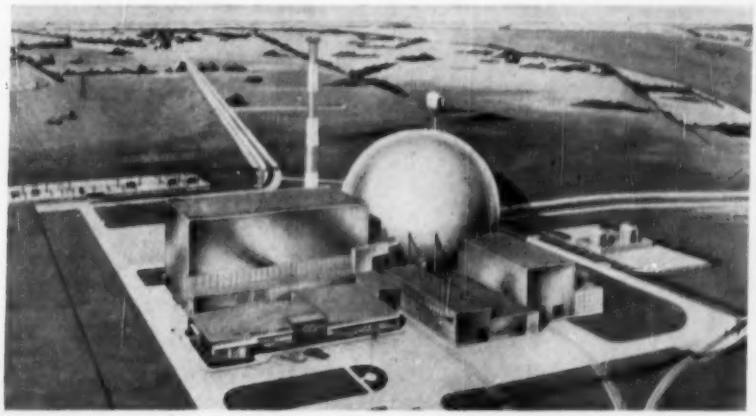


Fig. 7. Drawing showing the layout of the new Dresden Station of the Commonwealth Edison near Chicago. The reactor will be housed in the 190-ft steel sphere

Power Engineers Continue Steam, Hydro,

Utilities:—Supercritical steam plants; turbine-driven high-speed bf pumps; coal pipelines; 450,000-kw turbine generators; more automatic control; pumped storage; underground hydro; gas turbines. Industrial plants:—Small pressurized, supercharged and package boilers; new stokers and firing methods; fluid coke burning; waste fuels; rising coal consumption; high-temperature hot water systems

By CHESTER R. EARLE
Executive Editor
POWER ENGINEERING

DURING the past year, the developments in nuclear power, and in the supercritical steam power plants now under construction, have been watched with great interest by all power engineers. Nevertheless, the field as a whole must continue to build and operate conventional types of steam, diesel and hydro plants to meet the ever-increasing demand for more and more power, as explained in the preceding articles. This is being done with remarkable success and with much progress in plant and equipment design and in efficiency improvement.

As our systems grow in size and capacity, larger and larger units are needed. These are designed for better and better economy and reliability. To secure both thermal efficiency and compactness, steam pressures and temperatures are raised.

Aside from the six units now scheduled for supercritical pressure operation, a large number of the newer units will operate at pressures of 1800 psi to 2400 psi and temperatures of 1000 F, and some at 1050 F and 1100 F. The Eddystone supercritical 5000 psi unit is designed for 1200 F and several of the other large units for 1100 and 1150 F.

Many of the newer units are of 200,000-kw capacity or thereabouts, but several of 300,000 kw capacity and over are to be installed, like those for Con Edison and Philadelphia Electric. But the AG&E system will go farther and has ordered two units of 450,000 kw each. Some engineers are even predicting that much larger units can be and will be built in the future. A number of stations now have individual station generating capacities of 1,000,000 kw or more.

Power Station Heat Rates: In the utility field, five years ago, only two plants had heat rates below 10,000 Btu per kwh. In 1955 there were 41 below that. A number of the new stations, according to FPC, have heat rates like these: Philip Sporn 9341 Btu per net kwh; St. Clair, 9220 Btu per net kwh; Kanawha River 9151; Clifty Creek 9143; and best of all on the FPC list, Kyger Creek with 9110 Btu per net kwh. Even this fine record has now been broken by PSE&G Co's Burlington Unit No. 7, which for six months had an average heat rate of 9090 Btu per net kwh. But there is more: plants now being planned will have heat rates of 8500 Btu per net kwh. Still more: the Eddystone 5000-psi 1200-F plant* is expected to have a heat rate of 8016 Btu per net kwh.

Linden Station of PSE&G will exchange process steam for fuel with a nearby Esso refinery and also supply electricity to the refinery. As a result, Linden should have an overall thermal efficiency in the neighborhood of 54 per cent.

Heat rates like these result from careful attention to the design of every detail of the plant. How many boiler feed pumps are required and how shall they be driven and at what speed? What fuel, fuel handling and firing method? Shall the furnace be pressurized? What pressure levels for the various feedwater heaters? What water treatment? Disposition of drains? These and a hundred other details can save Btu.

Steam Generating Units: For the utility plants, single units of well over 1,000,000 lb of steam an hour capacity are becoming common in the newer installations; two are planned

* *Editor's Note:* Full details of the Eddystone plant were presented before the ASME Annual Meeting by J. H. Harlow, Paper No. 56-A-165; C. B. Campbell, C. C. Franck Sr and J. C. Spahr, Paper No. 56-A-156; and E. M. Powell, Paper No. 56-A-164.

Fig. 1. Monument to Courage, first 5000-kw turbine generator for Fisk Station of CE Co rededicated by G-E at Schenectady (PoE, December 1956)

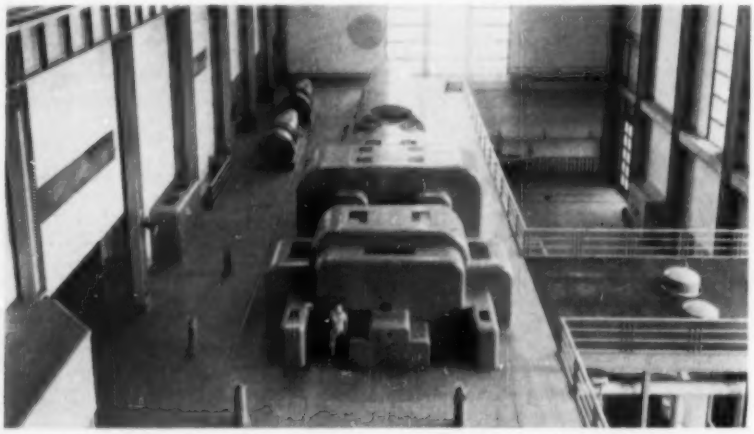
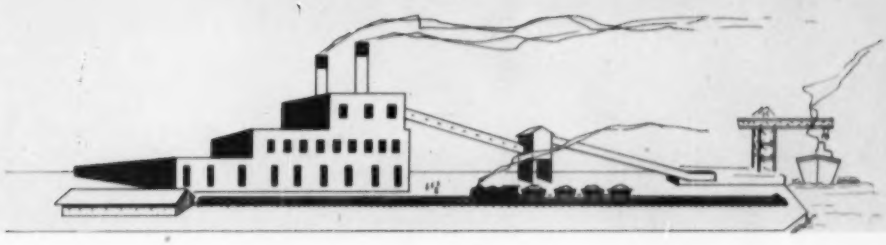


Fig. 2. This Westinghouse 200,000-kw turbine generator, Unit No. 7 at Burlington Station (PoE June '56) was most efficient unit in 1955, operating with heat rate of 9090 Btu per kwh. Steam conditions 2350 psig, 1100 F; reheat to 1050 F. Careful attention to all details of its design contribute to this good performance

IC Progress, Awaiting Nuclear Power



for just under 3,000,000 lb per hr for the proposed 450,000-kw units. For the Eddystone supercritical plant, a 2,000,000-lb-per-hr forced-circulation, once-through unit will make the steam.

In industrial plants, demand for fire-tube package boilers up to 10,000 lb per hr continues to increase. A recent development here is a small unit suitable for a single building heating system. Water-tube package units up to 25,000 to 30,000 lb per hr continue to be used frequently. But the average industrial boiler is around 50,000 lb per hr capacity.

Industrial steam pressures on the whole continue to be about 200 psi and below. The utilities continue to take over an ever-increasing proportion of the industrial electric power load, yet steam turbine generators for industrial plants continue to be installed, in capacities from 1000 to 8000 or 10,000 kw. But these form a constantly-decreasing percentage of our total generating capacity.

In both the industrial and central station fields, there has been much interest in the turbo furnace unit of Fig. 7, particularly for its effect in reducing stack dust emissions. There has also been interest in the increasing number of high-temperature hot water heating systems installed at various Air Bases and Navy Yards. Not too many industries have used them in this country yet, but a recent industrial installation in the U. S. will be described here soon.

Recent development is the supercharged boiler (PoE, June 1956) in comparatively small size, Fig. 8, in which a gas turbine drives a compressor to supply combustion air, the combustion gases from the boiler driving the gas turbine.

General trends in water treatment continue as they have for several years — increased use of demineralizers where applicable, yet reliance on hot process lime-soda and zeolite processes for many conditions. Several installations for purifying very brackish water or sea water for domestic and industrial uses have been made in this country and abroad. Some use steam evaporators or compression type evaporators, some use ionic methods.

Fuels and Firing Equipment: Fundamentals remain the same but details are being refined. For the utilities, pulverized coal is still the base fuel. Some simplification of handling methods for coal into and in the plant, as at Burlington, help to reduce firing costs.

For industrial use, several new forms of the vibrating grate stoker have been developed by manufacturers. Installations of these are now being made and performance data on them will be reported later. There is interest in burning a new refinery by-product, fluid coke (PoE, November 1956). Industrial boiler plants are burning oil and gas wherever the supply is firm; but the coal industry is beginning to find ways of meeting this competition by improving coal firing methods and equipment, especially in smaller plants. Industry is doing its best to use waste heat and waste fuels such as blast-furnace gas, black liquor, wood waste and the like.

Important development of the year has been the construction of the 110-mile coal pipeline (PoE, October 1956) through which coal is to be pumped by Pittsburgh Coal Co from Cadiz, Ohio to the new Eastlake Station at Cleveland.

Boiler feed pumps: As the turbine generator units and steam generating units have increased in size during

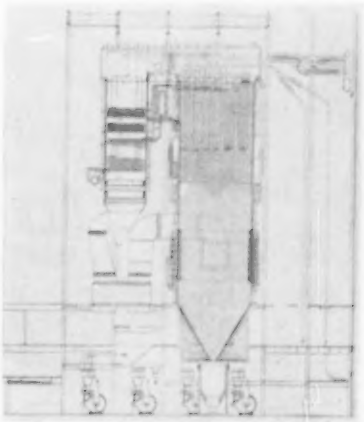


Fig. 3. Forced-circulation, once-through CE Co steam generator, supplies 2,000,000 lb per hr, 5000 psig, 1200 F for Westinghouse turbine generator

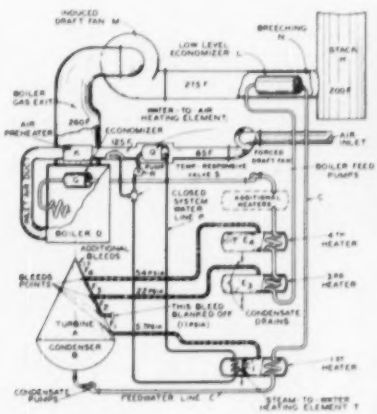


Fig. 4. At Eddystone supercritical plant, closed-circuit air-heating system and low-level stack-gas economizer, designed to cool stack gases to 200 F

Fig. 5. Section of condenser tube sheet with welded tubes, developed by Allis-Chalmers. First unit of this type, a 90,000-sq ft condenser

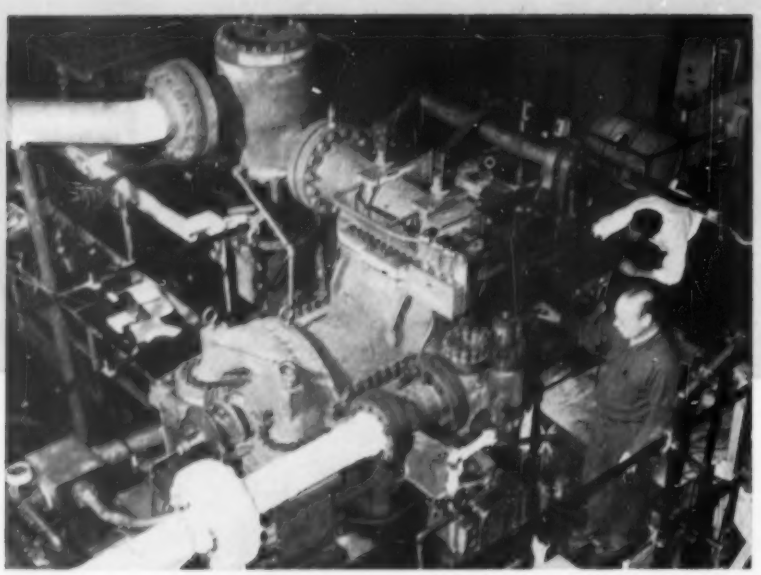


Fig. 6. For driving high-speed boiler feed pumps direct at 5610 rpm, this G-E 6230-hp steam turbine has been developed. Takes steam at both 600 psi and 2400 psi; for Glen Lyn Station

the past three or four years, a new situation has arisen in the field of the boiler feed pump. For many years, most economical boiler feed pump drive was considered to be the electric motor, with a steam turbine-driven pump for standby. For speed control, the fluid drive was often used with a constant speed motor.

However, as main unit sizes increased, it was found that the boiler feed pump required power of 4000 or 6000 hp and upwards and in one recent case, on a 325,000-kw unit, will reach 12,000 hp. Furthermore, as pressures and temperatures rose and large boiler units required larger and larger amounts of feedwater, the only way to do this was to increase pump speeds to 6000 or 7000 rpm, far beyond the 1800 and 3600 rpm of electric motors. This would keep down the size and operating problems of the pump itself. But with standard motor drive, a step-up gear would be necessary to get the required pump speed.

Consequently, for these new high-speed pumps, the steam turbine with a most efficient speed between 5000 and 7000 rpm, driving the pump direct, seemed the logical solution.

Here a choice between two methods arose. If the high-speed pump was to be driven by a steam turbine, why not let the main turbine generator drive it through a fluid coupling and, if necessary, a step-up gear? The main turbine generator in these large sizes, above 200,000 kw, cannot have direct-driven exciters, because of the commutation problem. So the boiler feed pump can go on that end.

Units of this type are being planned. First to be announced was the plan for a 12,000-hp Byron-Jackson 3510-rpm pump to be driven through an American Blower fluid coupling by the new GE 300,000-kw turbine generator at Astoria Station. For starting and standby, there will be two separate motor-driven pumps. Advantages are a large capital investment saving and elimination of controls, piping, auxiliaries, and saving of space.

Recently announced were two new Westinghouse 290,000-kw 2350-psi turbine generators to be installed in the Bergen station of PSE&G. Turbines are cross-compound but with low-pressure section running at 3600 rpm instead of 1800. The two sections each drive an identical electric generator and on each shaft is mounted a high-speed ½ capacity boiler feed pump driven through a step-up gear and a fluid drive. A motor-driven pump of ½ capacity will be used for standby. This plan is expected to save about $500,000 in first cost.

In contrast to these methods, General Electric is also producing a separate specially-designed steam turbine for high-speed boiler-feed-pump drive with big turbine generators (PoE, October 1956). First of these units, just shipped for the 225,000-kw unit at Glen Lyn, is shown in Fig. 6. Feed

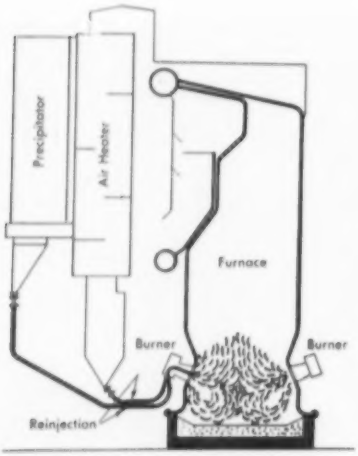


Fig. 7. Turbo furnace by Riley for firing any fuels and refiring fly ash, designed to eliminate fly ash emission and disposal problem and soot and slag blowers

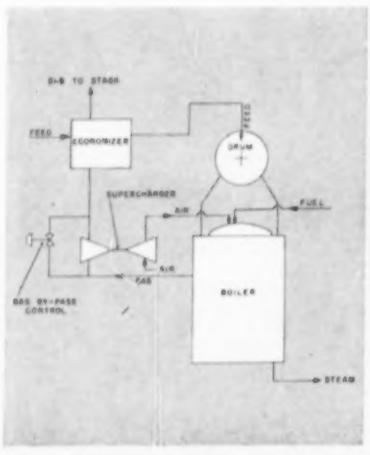


Fig. 8. Diagram of new Foster-Wheeler supercharged boiler; gas turbine can also drive electric generator; unit can also combine with steam turbine cycle

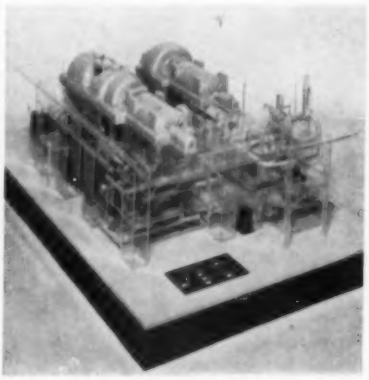


Fig. 9. For new large units like this 225,000-kw turbine generator at Glen Lyn, separate steam-turbine-driven 6230-hp boiler feed pump is used, shown at right hand corner of model. New development this year, as explained in text

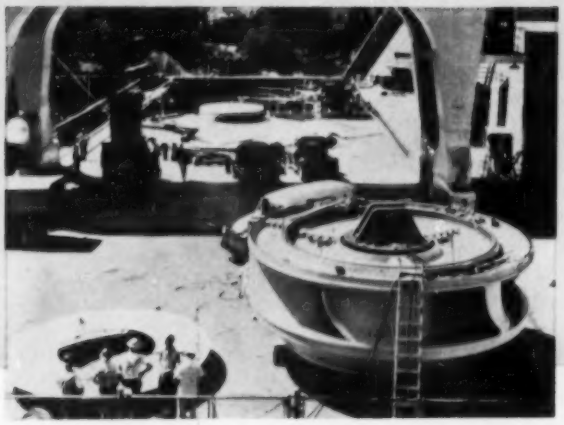
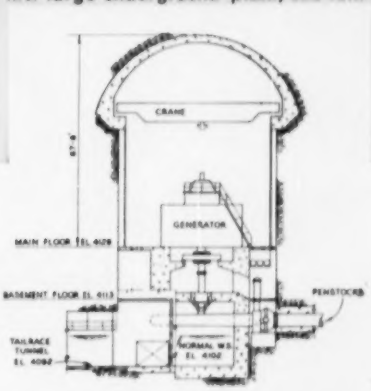


Fig. 10. (Left) Field assembly of 226-in. impeller runner for Hiwassee reversible pump turbine (PoE, May 1956), world's largest, built by Allis-Chalmers Mfg Co

Fig. 11. Section through Haas power house of PG&E on Kings River; to be first large underground plant; see text



pump turbine is 6230 hp, 5610 rpm, driving a Worthington pump direct at that speed. This plan is expected to increase the saleable kilowatt-hour output of the main unit by about 4 per cent and to produce a reduction in plant heat of from 10 to 20 Btu per kwh. Two other utilities, Niagara Mohawk and Cleveland, have also ordered separate boiler-feed-pump turbines of this type and about 15 quotations have been made to other utilities.

For the Eddystone supercritical unit, Westinghouse has also designed a special 5000-hp 5190-rpm steam turbine to drive the high-pressure feed pump, the low- and intermediate-pressure pumps being driven at constant speed by induction motors. (See ASME papers in footnote.)

The centralization of power plant control, which has been going on for some years now, must go still farther for the future very large units. Foreseeing this trend, control engineers and manufacturers have been developing control systems using electrical and electronic computers and co-ordinating devices that can operate a plant and even a complete system automatically, to give optimum performance.

Leeds & Northrup has its idea amplifier. Westinghouse has developed an automatic dispatch computer (Fig. 13) representing generation in 11 steam stations and one hydro station of West Penn Electric system. It shows optimum dispatch of power for the various units.

Also tried out at West Penn's Springdale Station is a newly developed B&W-Bailey electronic system (Fig. 12) that analyzes operation of a large steam generating unit, telemetering its results to a large electronic computer that analyzes performance. Kansas City Power & Light Co's system load is automatically dispatched by a G-E automatic dispatching system (Cameron and Mueller, ASME No. 56-4-215). Neches Power Station has a Panellit information center for its 6 turbine-boiler units. After installing the system, sufficient personnel were released to man new units. The installation is expected to pay for itself in 3 years (Reich & Gurney, ASME No. 56-A-219).

Gas Turbines: For a southern installation, a 15,000-kw open cycle gas turbine is now under construction, biggest one yet for continental U. S., but a 20,000-kw unit has been ordered for installation in Puerto Rico. These are the largest stationary units in U. S. for electric generation. Over 50 units, 1800 to 7000 hp, are driving pipeline compressors.

Hydroelectric: Total orders for hydraulic turbines rose from 4,628,000 hp in 1955 to 7,595,000 on order and scheduled for shipment on Oct. 1, 1956. There was only a trickle of orders for hydro equipment in 1954, but activity was great in 1955 and 1956. However, hydro plants still supply only about 20 per cent of our total power.

World's largest pump turbine, at Hiwassee plant of TVA, went into operation during the year. As a turbine, it develops 80,000 hp; as a pump it runs at 102,000-hp. Its 266-in runner, Fig. 10, sets a record for size.

Interesting development on the West Coast is PG&E's plan for the first large underground hydro plant in the U. S. It will be the Haas plant on Kings River development, will be 500 ft vertically below the surface, Fig. 11, and will contain, according to Johnson, Dinapoli and Cooke before AIEE, two vertical-shaft, multi-nozzle impulse turbines, each of 92,000 hp driving a 75,000-kva generator.

Fig. 12. Components of electronic system by B&W and Bailey to analyze operation of steam generating units, collect information from as many as 500 different locations

Fig. 13. Automatic dispatch computer by Westinghouse, for West Penn system, co-ordinates generation data in 11 steam stations and 1 hydro station for optimum system economy

New Horizons

Spur Electrical Progress

Continued growth of electrical demand in coming decades will stress industry's efforts to the utmost. Increasing complexity of the electrical art demands higher educational levels for electrical engineers. Dwindling fossil fuels make new energy conversion processes imperative

DURING the year just past the amount of electrical energy generated by the electric utility and industrial power plants in the United States reached the staggering total of more than 700 billion kwh. This represents over 4200 kw for each man, woman, and child in the nation. To produce this energy required an installed generator capacity of 135 million kw, almost 119 million of which are in the publicly and privately owned utility stations. This electric power production represents approximately 40 per cent of the world total.

A look at the chart showing the rise in generating capacity in the United States through the years (Fig. 1) shows that the installed capacity in 1956 is more than twice as much as it was 10 years ago, in 1945. At that time the installed capacity was 63 million kwh. While this doubling of capacity is impressive, of even greater significance is the steepness of the slope of the growth curve at the present time — it shows no sign of leveling off. Indeed, a study of the factors and conditions underlying the growth of the electrical demand shows nothing to indicate any diminution in decades ahead.

By 1966 the installed generating capacity will be around 270 million kw. The addition of such a tremendous amount of new generating capacity together with all it implies in the way of transmission and utilization equipment, during the next decade provides a challenge that will tax the skill, knowledge, and ingenuity of the electrical industry to the utmost. Even now, we are building electric generating units of 450,000-kw capacity — single-shaft generators of 265,000 kw, but still larger units will be built as the capacities of systems grow larger.

Activity in the electrical field touches almost every area of human endeavor. It involves equipment such as the *Mountaineer*, the world's largest power shovel, so huge that it carries a passenger elevator in the hollow center pin of the gear on which the boom structure rotates, to tiny transistors no larger than the head of a match for use in hearing aids. It deals with synchrocyclotrons used in nuclear research developing energies of 10 billion electron volts as well as with delicate electro-biological techniques for measuring the infinitesimal electric potentials arising in a single optic nerve fiber resulting from the impact of a few quanta of light energy on the retina of an eye. More and more, we are discovering that all biological and chemical processes are electrical in nature. By means of the electrocardiograph we measure the electrical impulses produced in the heart. The electroencephalograph similarly, records electrical activity in the brain. Now the electrical response of the retina of the eye can be recorded by the electroretinograph.

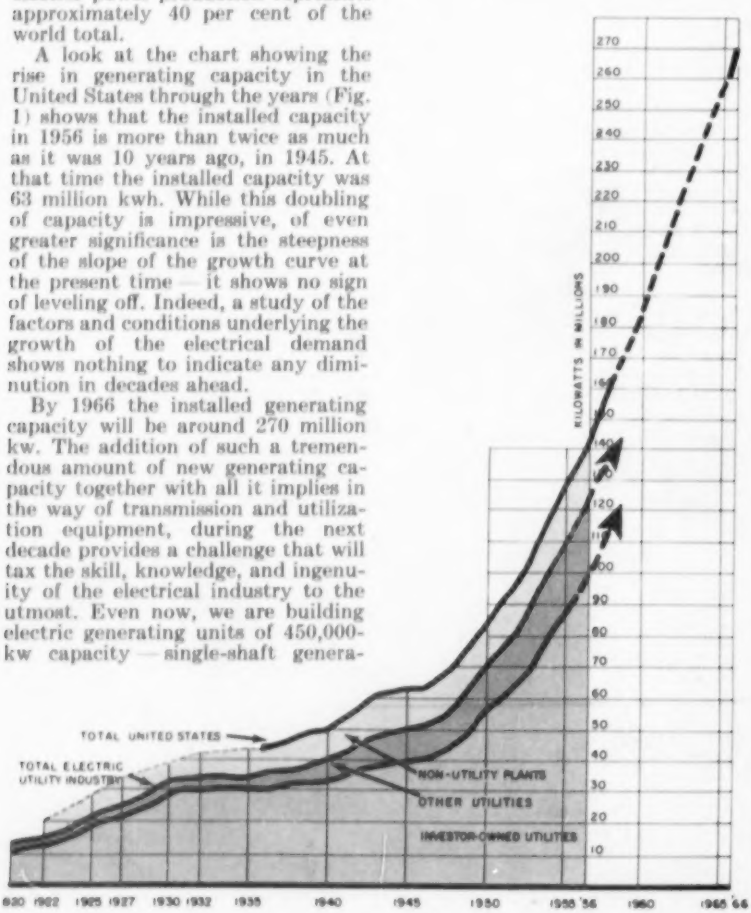
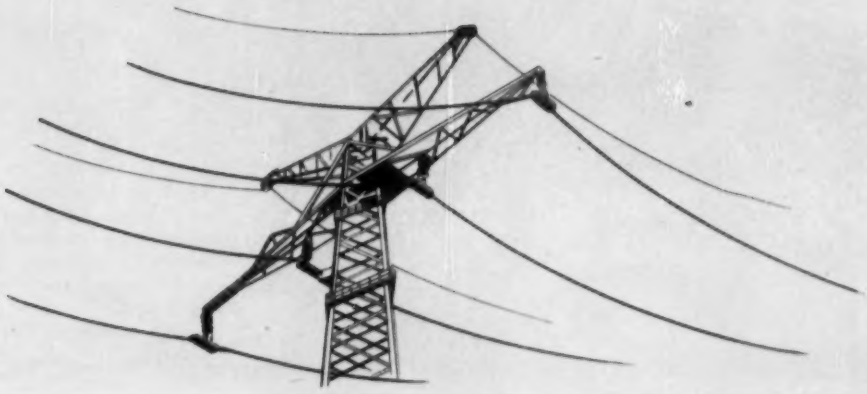


Fig. 1. Chart showing the increase in the demand for electrical energy in the United States. By 1966, installed capacity will reach 270 million kw

Electrical equipment enters into almost every aspect of our existence. Even such purely mechanical devices as machine tools, in addition to being powered by electric motors, are now controlled by electronic systems, indeed in some instances the human operators of such machines are being displaced by electronic computers. Even routine engineering design is being done by computers. Mechanical engineers, for example, in the design of power plant piping systems find that the use of the electronic computer can save them weeks of laborious calculation. By feeding dimensions taken from isometric drawings into the computer, the machine turns out results in a matter of hours that otherwise might take weeks to attain.

In short, electrical engineering has become a very complicated business and is steadily becoming more so. This is true, first, with respect to the level of technology with which the electrical engineer is involved. A transistor, for example, is more difficult to understand, has more complicated properties, and is far more difficult to manufacture than the vacuum tube which it is beginning to replace. A large interconnected electrical transmission and distribution system is more difficult to design and maintain in a state of stability than smaller systems, and requires far more complex control and regulating apparatus. Second, once a new and complex electrical device is created, the electrical engineer immediately proceeds to combine it with other



equally complex devices to produce a system that is still more involved.

Basically, the principle of the alternating-current generator is relatively simple, and in years past, when machines were small, and natural cooling was the rule, the designers' problems were quite simple. This is not so today when, in the large machines now under construction, the electrical engineer combines the magnetic and electrical structure of the machine with elaborate "plumbing" systems and heat exchangers for forced cooling with liquids and gases. The first generator using liquid cooling of the stator conductors is now in operation at Eastlake Station in Cleveland but it probably will be only a matter of a few years before we go to liquid cooling of the rotors of such large machines.

Another branch of electrical engineering which formerly was quite simple but is now growing in complexity is that involved with magnetic materials. Here we are concerned with such things as cermets and many new alloys which produce powerful permanent magnets. Most of us are familiar with the powerful magnetic properties of nickel-cobalt. Now under investigation is a new magnetic material involving manganese and bismuth. Westinghouse Electric Corp carried out the major research in this material under the leadership of Dr. Zener but now the Air Research and Development Command (ARDC) is studying the material. The superlative magnetic properties of pure manganese-bismuth have been predicted for several years but until now the pure form could not be attained. Aside from their super-strength, the new manganese-bismuth magnets have at least ten times as much resistance to demagnetization as existing magnets.

Thus, as Dr. F. E. Terman, Dean of the School of Engineering at Stanford University pointed out at the Fall Meeting of the AIEE in Chicago last October, the young electrical engineer today must know more engineering and science than was expected of him 20 years ago. In addition to familiarity with electrical circuits and equipment, he must have an ever-increasing knowledge of electronics, be familiar with servomechanisms, and know something about such fields as statistics, atomic and nuclear physics, and solid state physics. If he becomes involved in a difficult mathematical problem, he is expected to use an electronic computer to get out his answers.

It appears, therefore, that perhaps the most challenging problem the electrical industry faces to pave the way for the tremendous growth during the coming years, is in the education of its future electrical engineers. A number of significant changes are taking place in curricula for training electrical engineers. First, greatly increased emphasis is being placed on the basic sciences and on fundamental engineering principles. Second, the undergraduate years are being used with increased efficiency. Third, the time devoted to college training is, on the average, being extended. Fourth, adult education is growing in importance.

There is much more to the problem of engineering education, however, than merely changing the curricula in our better colleges. Of far greater importance is the need to stimulate interest in engineering and science at the lower educational levels — in the grade and high schools. As pointed out recently by Admiral Rickover, unless this crisis in education is dealt with promptly and effectively, the machinery which sustains our level of material prosperity will begin to slow down, endangering not only our economy but also our position in the world. Last year, in the United States, we graduated only 23,000 engineering students against a reported 63,000 in Russia.

A specific aspect of the problem is our failure to identify and develop our talented youth. Half of our children who are endowed with the ability to enter college do not do so. For every high school graduate who eventually earns a doctoral degree, there are *twenty-five* others who have the mental capacity to achieve that degree, but do not. If our schools have

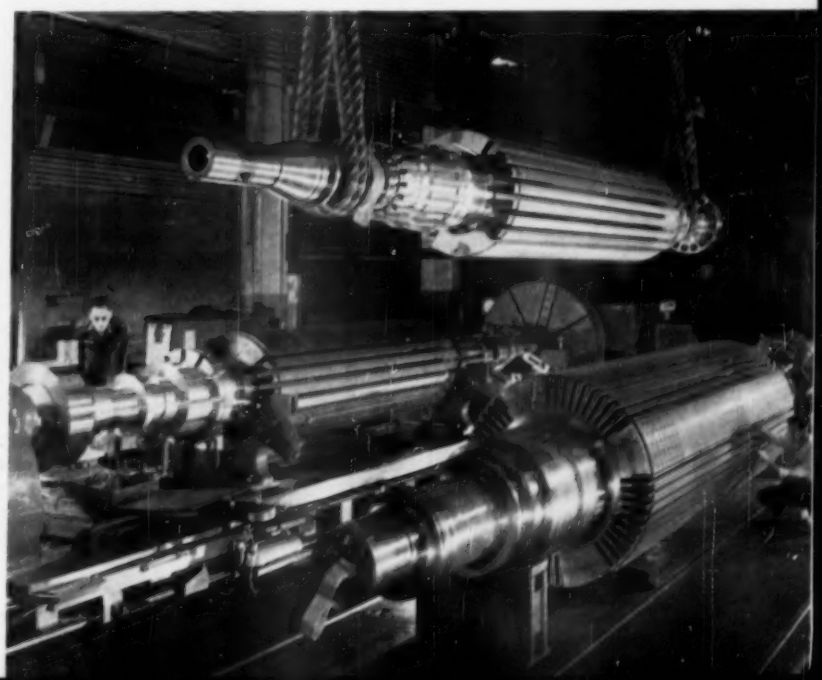


Fig. 2. Nearly 500,000 kw of America's future electric power is represented in these turbine-generator rotors at the Allis-Chalmers West Allis Works. The 76-ton, 1800-rpm rotor on the blocks and its 35-ton, 3600-rpm partner suspended from the crane are for a 300,000-kw unit for Detroit Edison. Another 3600 rpm unit for a 150,000-kw is shown in the lathe

Fig. 3. Actual computations for designing a complete high temperature piping system take less than one hour on the electronic computer. Blaw-Knox Co used this method in calculating piping stresses at the Frank M. Tate Station of Dayton Power & Light Co.

succeeded in inspiring a love of learning in these children they would have become professional men and women and we would not be faced with a deficiency of scientific manpower.

There was a time when there were few places in industry where a doctorate in electrical engineering could profitably be applied. Today, the more training an electrical engineer possesses, the more versatile and capable he becomes. There is no such thing as an overtrained electrical engineer today. Rather, although there is a shortage of engineers all around, the shortage is greater in the higher level of training. "Catch-as-catch-can" learning from on the job experience is not adequate for the needs of the future, let alone those of today, in areas where the technology is new and advancing rapidly.

Of considerable interest in the field of electrical engineering education is the fundamental revision of undergraduate electrical engineering training at Massachusetts Institute of Technology. The revised curriculum comprises a group of 8 core subjects, 3 of them organized under the broad title of Energy Conversion, provide electrical engineering students with an understanding of the conversion, utilization, and control of electrical energy. Not mere substitutes for the traditional a-c and d-c machinery or power transmission subjects, the new program and its contents recognize imaginative processing of energy as a major responsibility of engineers.

The curriculum recognizes the recent abundance of new materials, environments, energy sources and calculating machines, and the fact that fields of feed-back control systems and automation manifest 2 activities that cross the traditional boundaries between fields of machinery, electronics, circuit theory and communications. Briefly, it proposes to adequately equip electrical engineers for advancing technology in any industry.

The field of energy conversion offers a number of extremely challenging problems to electrical engineers during coming decades. Among the more important of these challenges, in the face of our dwindling petroleum resources, is the development of a really good, high capacity storage battery to power automobiles, trucks and railroad locomotives. We use 4 times as much fuel for internal combustion engines as for the generation of electric power, and we pay 14 times as much for the fuel. We have based the major part of our existence on liquid fuel, yet we face the prospect that supplies will soon be inadequate even for the present population, consequently, we can look forward to a profound revolution in automotive transportation within the next few decades.

Development of *fuel cells* that produce electricity from such gases as hydrogen and oxygen, is another field

Fig. 4. The Fuel Cell, a battery that produces electricity from such gases as hydrogen and oxygen is under investigation at Union Carbide's new Parma, Ohio research Laboratories

which offers possibilities in the process of energy conversion, and some progress is being made.

Where ordinary batteries utilize energy obtainable from metals and other substances in the form of charged particles, recent research indicates that it may be possible to make a battery which will obtain its supply of charged particles entirely from such gases as hydrogen and oxygen. A possible version would include two basic unit sections. One section would consist of l[illegible] of porous carbon and a liqu[illegible] paste caustic solution with a space between. Oxygen gas would stream into the space, and its molecules would move through the submicroscopic tunnels and channels in the porous carbon. When the molecules reach the caustic layer they form a film, and reactions take place which produce negatively charged particles. This is the electron-consuming or *positive* section of the battery. The other section, the electron-supplying or *negative* unit is constructed in a similar fashion. It makes use of a stream of hydrogen gas which reacts to produce positively charged particles.

Most glittering dream of all with respect to energy conversion, however, is the development of a *controlled* thermonuclear process. This would not only provide mankind with an unlimited source of energy but also, for the first time, make possible the direct conversion of nuclear energy into electric power, without the necessity of going through a heat cycle. This cannot be done with the present type of *fission* reaction. Fission is, basically, thermal energy. In the fusion process, however, particularly in the deuterium-deuterium reaction, more than $\frac{2}{3}$ of the released energy is emitted in the form of charged particles which, because of their electric charge, will not escape from the field which confines them. Since the confining field is itself electromagnetic in character, the interaction of the released energy back on the confining field may, under proper conditions, be expected to result in the direct generation of electrical power. This, of course, is theory and a great many formidable problems will have to be met and solved before it can ever become a reality.

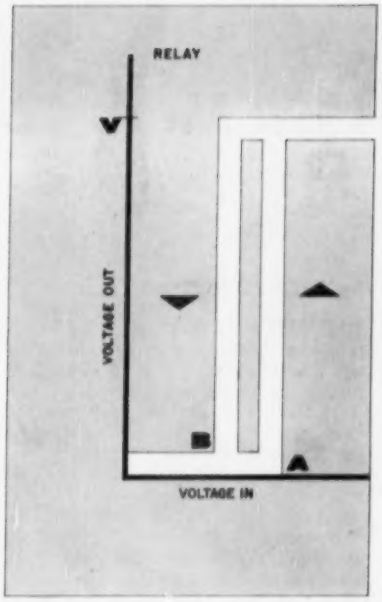


Fig. 1. Characteristic curve of a relay, i.e., plot of input vs output voltages

What Does Static Switching Mean?

IN RECENT years a number of the country's leading electrical manufacturers have developed switching systems requiring no moving parts. These systems and components carry various trade names, but when used individually or as part of an integrated switching system, they give much greater reliability and speed of operation than similar systems using conventional types of electro-mechanical relays.

Letters from our readers have indicated that many of them are puzzled about the basic concepts of these switching systems, so here is a brief description of the principles on which they are based.

Let us first consider the action of a conventional normally open relay. Figure 1 shows the relation between input and output voltages. When the input voltage is less than A, the relay remains open and the output voltage is zero. At A, the closing voltage is reached, and the output circuit of the relay might show a voltage of V when the relay closes. Any higher voltage than A does not affect the output, since the relay is already closed. If we now reduce the voltage, the relay will hold in at a lower voltage than the closing voltage, so it will only drop out at some voltage such as B. Naturally, for any voltage less than B, it will remain open, with zero output voltage.

Static switching devices depend on the properties of high-grade ferromagnetic materials. Figure 2 shows a comparison between the hysterisis loop for a turn-of-the century transformer steel and a modern high-grade magnetic alloy. It will be seen that with the modern steel a very sharp increase of flux density is obtained at a particular value of magnetic field. By suitable circuit arrangements this property can be used to construct a magnetic amplifier with positive feedback that gives an input-output curve as shown in Fig. 2B, which, it will be seen, is very similar to the input-output curve for the conventional relay.

Another device used is the transistor. Relation between input and output for a transistor shows a sharp increase in output voltage for a certain value of input volts. With suitable circuit design, some of the output power of the transistor can be fed back into the input to give a curve of roughly the same shape as that shown in Fig. 2B. This again is similar enough to that of the conventional relay to be able to do the same job.

Another device which forms part of the system is the contactless switch, which can be in the form of a push-button or limit switch. Figure 3 shows the principle of operation, which depends on the change of impedance of a coil. Rotation of the lever-arm moves a permanent magnet away from the reactor. The core is saturated by the magnet when it is in one position, and unsaturated in the other. This change in saturation can be converted into an on-off function with the aid of the other components in the system, with no mechanical contacts anywhere in the circuit.

It will be seen that, apart from the high speed of operation of these components, they have an enormous advantage in terms of reliability. However well a mechanical relay is constructed, the constant problems of contact sparking, erosion, mechanical friction, and jolting are bound to give it a shorter life compared with these contactless, frictionless devices.

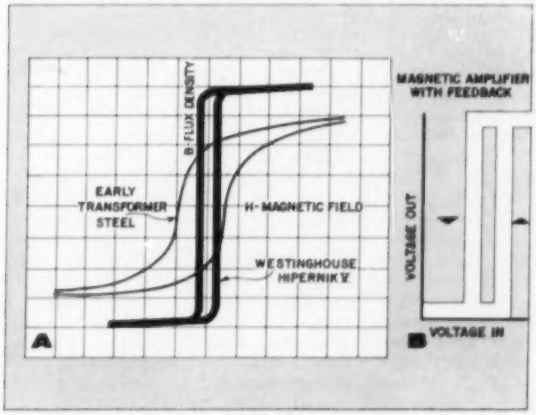


Fig. 2. Comparison between a Hypernik-V hysterisis loop and that of an early transformer steel. Right: Output vs input curve of mag amplifier with positive feedback

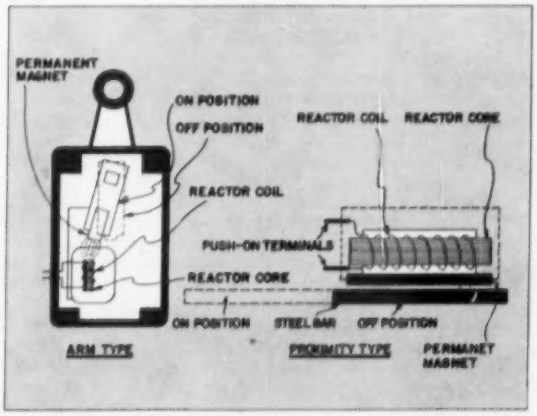


Fig. 3. Contactless limit switch. Lever arm rotation moves permanent magnet. Reactor core is saturated by magnet in one position and is unsaturated in the other position

How Much Coal in Your Stockpile? . . . . *How* Do You Know?

By **FRED M. REITER***

IMPORTANCE OF knowing at all times the exact tonnage of coal in the plant storage pile is necessary for the following reasons:

1. Coal has an inventory value that must be carried in the records for financial and tax reports.

2. Total value of all coal on hand and received for current consumption must be figured in determining the true cost of steam in making the final product. The destination cost of all coal in storage may have considerable weighted effect on the average cost to be charged to production. Tonnage in the stockpile must be known.

3. When the supply of coal becomes affected by mine or transportation strikes or delays, car shortages, or other failures in the flow of coal, the tonnage or days of supply available in the stored reserve must be determined in order to establish a program of building up ahead of the expected shortage, or for replenishing the tonnage after depletion.

4. When coal prices are scheduled to rise or fall, it may be desirable to lift or drop the storage level as a matter of economics, taking advantage of lower prices for stockpile procurement.

Two Methods Used

There are two methods of learning how much coal is in stock: (1) by recording input and outgo; the amount of coal purchased and received, less the quantity removed or consumed; and (2) by measuring the volume and computing tonnage in the system. Most enterprises do both. They run daily, weekly or monthly balances between input and take-out, then periodically make an inventory check of stocks on hand; a convenient cut-off time is set for taking all readings and weights. The daily records and the inventory must check within reasonable limits.

Methods of maintaining constant continuing records along with a running inventory are many and varied. In our firm, there are four separate sets of records or reports made up by different departments, each for different purposes or to show specific objectives. The purchasing and stores people derive their specific figures as a routine stock control item.

The Power Production Div. is concerned with the supply on hand as a reserve in case the normal daily flow of fuel for their boilers becomes jeopardized. The Accounting Division studies the financial and fiscal angles of money values for the various phases of accounting operations for management, stockholders, government reports, etc. The Auditing Department makes up the physical inventories and other checks or verifications of all phases of our fuel operations.

Daily Reports Are Basic

All of these findings are founded upon the basic daily entries or reports from the operating departments. These daily records are designed for the utilization of the International Business Machine punch card system by our Accounting Department, as described in a previous article in POWER ENGINEERING *. Each day, Fuel Section of the Power Production Division receives shipping notices from all coal sources, giving car numbers and coal identification data. Each car of these notices is assigned a card on which is punched the number, identity of coal, dates shipped, etc. (Fig. 1). Each day the data from these cards are printed on a sheet for internal distribution as "coal in transit".

At the same time, the Traffic Department supplies, to the IBM machines, the weights for these identified cars as the railroad freight bills are received. Every day the coal-handling foremen telephone the Fuel Section to report the actual cars received, car numbers, and identification data. When the numbers are punched on the cards as "received," these cars become "on hand" instead of "in transit." During the same phone conversation, the cars actually unloaded and delivered back to the railroad interchange track are recorded by the Fuel Section and transmitted to the IBM cards.

The machines drop the cards from the collection so that when the day's cards are printed, the unloaded cars fail to appear on the records. They have been "consumed," or fed into the bunkers for firing; they have been removed from inventory. These data on cars received and unloaded are transmitted to the IBM-machine Accounting Department on separate station coal reports (Fig. 2), as illustrated. Each station has differently colored sheets for quick identification.

Truck loads are handled in the same manner, except that since trucks are weighed at each plant on our own scales, the Fuel Section forwards these weight slips directly to the IBM-machine department along with the unloading reports as a single operation. No in-transit entries are carried for trucks because these are unloaded within two hours after being loaded at the North Bend docks on the Ohio River near the city of Cincinnati.

Basic record for every ton of coal received now rests in the IBM-machine system. This coal is carried in the machine until the car or truck is unloaded, whether into the bunkers, pits, or storage pile (or moved out of the plant, which rarely occurs). Each interested department receives the daily summary printed automatically from the cards remaining in the system, for each station. The Statistical Section puts out a daily report of the tonnage burned, along with data on power generation, etc., without reference to any changes in storage conditions.

Sources of Information

They have several sources for this information in addition to reports on coal received and unloaded. At the end of each month, the Statistical Section prints a set of monthly inventory sheets as the official totalized inventory of all coal on hand at each station, whether in the storage piles, bunkers, pits, cars, trucks, or anywhere else. This is chiefly for accounting purposes. Similarly, the Purchasing and Stores Department totals all of the coal on hand at each station for the "inventory" of that material, including stockpiles, cars, trucks, bunkers, pits, etc., lumped as one sum.

Power Production Division is interested in the coal located separately in the storage piles as fuel reserve. Coal contained in the bunkers, pits, cars, trucks, etc., is part of the pipe-line flow of fuel moving to the burners. It is not a part of the fixed fuel reserve. Fuel Section segregates the coal into each of the types of location: storage pile, cars, trucks, etc.; they carry the tonnage of coal consumed, received, unloaded, left in cars, contained in bunkers and pits, etc., separately. This is the only report that lists coal actually in the storage piles. It is made up weekly, starting each month fresh with the new storage pile content.

Weekly report data is then ac-

*See: How We Use Punch Card Records in Buying Coal, POWER ENGINEERING, April 1955 issue.

* Formerly, Fuel Engineer, Dayton Power and Light Co

Fig. 1. (Below) Punch card like this is made up for each car of coal due to be received at Dayton P&L stations

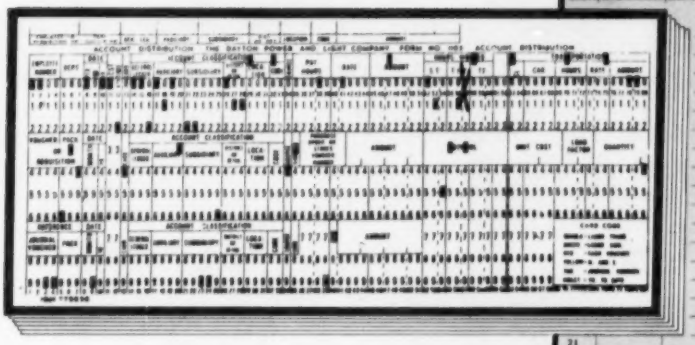


Fig. 2. (Right) A station coal report; each of the stations has its own color for easy identification; this is green

COAL REPORT

Cars Received — F. M. TAIT STATION — Time

	INITIAL	NUMBER	CARS PLACED	CARS LOCATED	DEBIT	CREDIT	ADDITIONAL DATA
1							
2							
21							
22							
23							
24							
25							
26							
27							
28							
29							

TOTAL

OTHER THAN COAL

REPORTED BY

Fig. 3. (Below) A weekly report form. This is only report that actually lists quantity of coal in storage stockpiles

To: Mr. J. Jones — Fuel Department, Power Production Division

Subject: Coal Situation: Cumulative Totals for the Month

COAL OPERATIONS: March 1 thru March 31, 1955

STATION 1955	Storage Pile Inventory Tons	Total Coal Unloaded Tons	Total Received: Coal Tons	Trucks	B.B. Cars	Unitrod Cars: Unloaded	Left on Track*
F. M. TAIT							
March 1	46,906.28						
" 1 to 31	10,111.65	8,412.65	0	137	141	0	
" 31	45,967.28						
Change in Storage Pile	- 1,139.00	Cost in Bunkers and Pits: 2,115.83 Tons					
		Cost in Cars: 21 Tons Each					
O. H. HUTCHINGS							
March 1	218,518.29						
" 1 to 31	73,300.80	54,301.90	1382	531	548	10	
" 31	200,753.99						
Change in Storage Pile	-18,061.30	Cost in Bunkers and Pits: 2,846.25 Tons					
		Cost in Cars: 0 Tons Each					
LONGFORD STREET							
March 1	30,698.87						
" 1 to 31	8,476.35	7,391.10	0	111	113	0	
" 31	29,719.62						
Change in Storage Pile	- 950.25	Cost in Bunkers and Pits: 795.46 Tons					
		Cost in Cars: 0 Tons Each					
MAIN STREET							
March 1	6,982.66						
" 1 to 31	5,726.95	5,981.15	0	61	63	9	
" 31	6,689.76						
Change in Storage Pile	- 467.70	Cost in Bunkers and Pits: 759.27 Tons					
		Cost in Cars: 9 Tons Each					
TOTAL							
March 1	303,376.90						
" 1 to 31	97,103.65	76,687.40	1382	840	867	10	
" 31	282,530.65						
Change in Storage Pile	-20,846.25	Cost in Bunkers and Pits: 6,516.81 Tons					
		Cost in Cars: Tons Each					

*Not included in storage pile inventory. Not included in coal received

Date: 4/14/55 — Fred H. Rosser

Fig. 4. (Below) A daily report form from one of Dayton P&L's stations sent to Fuel Section to verify phone reports

THE DAYTON POWER AND LIGHT COMPANY

COAL REPORT

O. H. HUTCHINGS STATION

Date: Sept. 7, 1955

To: Mr. William Roe

ON HAND YESTERDAY		64 cars
UNLOADED TO BUNKER	36 cars	
UNLOADED TO STORAGE	6 "	
TOTAL UNLOADED	42 "	42 "
BALANCE		22 "
RECEIVED 7 A.M.	38 "	
RECEIVED 10 A.M.	0 "	
TOTAL RECEIVED	38 "	38 "
TOTAL ON HAND		60 "

Remarks: 13 night loads 279.75; 37 day loads 702.65; 50 " 982.40 storage 310.55

Fig. 5. (Right) Another version of form in Fig. 4; this is used by different station in system but serves the same purpose

OFFICE INFORMATION — The Dayton Power and Light Company — Date 9/8/55

To: William Roe

Subject: Daily Coal Report

Wednesday 9/7/55

Cars received	16
Cars to Dunmore	9
Cars to Storage	4
Consumed: 1,050,800	
On hand Thursday AM	
Cars in Yard	10
(Received at 7 AM	4)

John Doe

cumulated for each week, across the sheet, until the end of the month, at which time this report constitutes a monthly report that must check with the monthly coal report of the Statistical Section of the Accounting Department; then the next month's data is started anew.

Strike Dents Storage Pile

Figure 3 shows a weekly Coal Situation form reflecting the effect of a railroad strike that took 18,000 tons out of storage at O. H. Hutchings Station.

As a check on the reports obtained directly by phone from the coal handling sections of the stations, the Fuel Section receives daily coal reports from the chief clerks of these stations, showing the rail cars and trucks received, unloaded to bunkers or storage, or left on hand. Figures 4 and 5 illustrate these reports. They form the basis of keeping our daily car situation as a matter of movement and supply, for a quick check on the uniformity of the delivery of our coal.

After checking with the information received directly from the coal handling departments for possible error, the car situation is entered daily on a "Monthly Coal Summary" sheet, Fig. 6A, for each station. This summary sheet is maintained informally in the Fuel Office for a quick glance at the logistics or supply line of our incoming coal.

Since it takes 5 days for cars of coal to arrive, from the date of the shipping notices or departure from the mines, we can visualize whether we are running short of coal or building up too many cars in transit. Our stockpiles will be affected in either case. We take out or put in if we run short or get too many cars on the tracks.

Column 8 of Fig. 6A tells us the total number of cars that are on all of these tracks. We may have to unload them all in about 5 days. It is the sum of col. 2, cars on hand, in yard, and Col. 7, cars on the way, in transit. If we burn an average of 40 cars daily, and our total exceeds 200, we are heading for excess coal that may have to be put into storage in order to avoid demurrage. If this total goes the other way, i.e., falls under 100 cars total, we are going to be out of cars of coal in 3 days. If we cannot increase shipment and this total quickly, we must remove coal from storage piles.

The cars left over after the day's operation, col. 6, is the sum of col. 2, cars on hand at the start of the day, less the sum of cols. 4 and 5, cars unloaded into bunkers and into the storage pile. Column 2 is the sum of col. 6 of the previous day plus col. 3, today's receipts.

The totals for each week for cars received and unloaded to bunkers should be equal, if the storage pile is to be untouched. It takes careful shipping by suppliers, prompt deliveries by the railroads, and proper ordering by the coal buyer to maintain a constant stockpile. Power and steam loads must remain constant and exactly as predicted by the forecasters of coal requirements given to the coal buyer if the status quo is to be maintained. It usually requires continuous watching and control of coal movements by the Fuel and Traffic Sections in order to preserve the profiles of the storage piles, and to keep the cumulative debits safely below demurrage credits on our averaging agreement.

Fig. 6. Monthly Coal Summary (A) is made up for coal at the company's stations; this informal typewritten sheet provides a quick reference in Fuel Office for logistics of supply line. Forms B and C are records used in annual inventory

Inventory Made Yearly

Once every year a complete physical inventory is taken of all of the coal on hand. Figures 6B and 6C represent two forms used in this annual inventory for recording at the given cut-off time, the coal in bunkers, pits, cars, trucks, and wherever else coal may be found. Coal meter readings are recorded during the taking of the inventory to check the coal removed from bunkers from the time of filling to the precise cut-off time. Simultaneously the cubage of all coal piles, their volume in cu ft, is carefully measured and computed by experienced survey crews. At the same time, our laboratory personnel determine by careful multiple sampling throughout these volumes of storage, the average density, in lb per cu ft, of the coal in each stockpile.

By use of these methods, actual physical tonnage on all of our properties is determined. These are checked against the year's records of coal received, burned, left over, or removed from storage. The two results must check to the satisfaction of our auditors who watch all of these operations personally. It is important that good records of all the movements and handling of cars of coal received, consumed, and left over have been kept throughout the year since these are the records of our coal stockpiles.

Active in promoting reporter session at ASLE meeting in Atlantic City were (l to r) F. W. Ocvirk, Vice-Chairman; Fred Macks and D. Fuller, Reporters; Stanley Abramovitz, Chm, Planning Committee; Don Wilcock, Session Chairman

ASME-ASLE proves . . . Engineering Meetings Need Not Be Dull

ONLY BRIGHT SPOT in the semi-darkness is a glaring square of light criss-crossed by a jumble of cabalistic symbols and mystic formulae, dimly seen . . . paneled doors are shut tight against the intrusive world, and the air — heavy with ritual smoke — is stifling . . . a voice drones on and on . . . slowly, inexorably, the eyelids droop, the feebly struggling will succumbs to the hypnotic spell . . . you sleep.

Are these [you may well ask] the rites of a dread and secret order? Not at all, simply a factual description of the average engineering society meeting we all attend time after time. Of course, after dozing through an hour-and-a-half of such a session, we remark sagely to our neighbor, "Good meeting . . . fine paper." He, blinking the sleep from his eyes, agrees soberly; after all, neither of us will have the other know that we heard only the chairman's opening remarks.

Try New Approach

Aware of these impediments to general participation in large meetings, members of the ASME-Lubrication Division and the American Society of Lubrication Engineers decided to try a new approach at the Atlantic City ASME-ASLE Conference in October. This approach was the socalled Reporter Session, a method widely used in Europe and one which was partly responsible for success of the recent World Power Conference in Vienna and the CIGRE conference in Paris, reported in the August and September issues of POWER ENGINEERING.

Best way to describe the Reporter method is to report the session at the ASME-ASLE Conference during the morning of Oct. 10, 1956.

Notice that such a meeting would be held was made in advance publicity, and its occurrence and purpose explained in all prior sessions during the previous two days of the conference. All papers to be presented were available in advance; members were admonished to study those of interest to them and be sufficiently familiar with their content so that fruitful discussion could develop on the floor during the meeting.

Chairman Donald Wilcock opened the meeting promptly at 9:00 A.M. to a full house of about 200 and again explained the procedure to be followed. Thirteen papers would be discussed; seven in the first half and, following a 5-min break, six in the second half.

A microphone, with an attendant to place it near speakers from the floor, was located in each of the two aisles. (Tape recordings were made of all discussions and are to be transcribed for later distribution and written discussion.)

Authors of the first seven papers were introduced briefly to the audience with a short sketch of their present connection and background to establish their authority in the field The first reporter, Fred Macks, devoted seven minutes to the introductions, then launched into a concise discussion of the general area the papers would cover. This served to orient the importance or significance of the individual contributions.

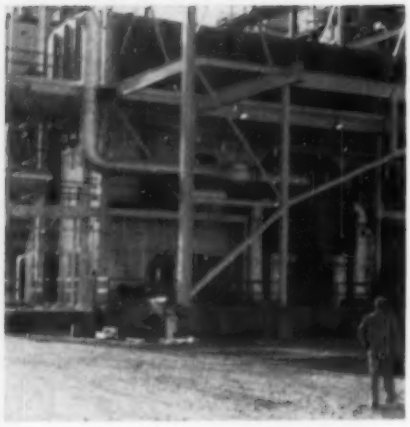
Macks next presented the highlights of each paper; he also served as critic by evaluating the style, completeness, and organization of both the report and the work it represented. He raised questions, indicated weaknesses, and pointed out where general discussion might bring out facts not clearly expounded in the paper. This reporting took approximately half an hour, then the meeting was thrown open to discussion from the floor.

Most Sat Tight

Discussion and comments were slow to start. Perhaps this kind of meeting was too new to the audience, and most merely sat tight and waited to see what would happen. Members who did rise to speak were generally cautious in their comment, praising the author fulsomely or mildly, as they were minded, then raised their points politely. This diffident attitude resulted in uninspiring discussion. About 14 men took part.

When no further discussion was forthcoming, the reporter declared this phase closed and called upon each author *continued on page 92*

Effective Scheduling Eases Power Plant Start-Up



After the plant is built, much still remains to be done, and there isn't too much time to do it. With only 16 to 20 weeks in which to clean, flush, test, and adjust the boilers, turbines, instrumentation, and auxiliary equipment, everything must be done at right time. Effective scheduling of these preliminary operations is only answer

By J. H. HUNNICUTT*

DESIGNING A NEW steam electric generating station normally encompasses a span in time ranging from 9 to 14 months; size of the installation, conditions of operation, and extent of innovation determine, to a large degree, the length of the design period. The construction period will range upward of fourteen months, and while the design and construction phases may overlap to a degree, it is a very rare instance when project completion will follow the initiation of design by less than two years.

It follows that putting into operation an undertaking as complex as a power plant will require great attention to detail. Furthermore, only 16 to 20 weeks are allotted to clean, test, and run-in auxiliaries, test and clean the boiler, adjust instrumentation, and finally, to put the plant into trouble-free operation. This necessitates close scheduling and elimination of all wasted motion.

Organizing Work Force

Obviously, to accomplish everything necessary to prepare the plant for operation within the time allotted will require some sort of organization, and more important, particularly when the new plant is an extension to an existing one, coördination between construction forces and the operating group. The organization will require an experienced and capable head and this person, generally a specialist in the employ of the Constructor, should be designated in a conference between the Construction and Operating management groups which should be scheduled at least 4 months in advance of the anticipated date for commercial operation.

At the same time, the Operating Group should detail a person, preferably a shift foreman or senior operator, to assist the Start-up Engineer. This person should have the ability and authority to order the various systems and components of the existing plant into and out of operation as necessary without seriously disturbing the operating plant.

Such plant operators as can be made available should be detailed to the actual operation of valves and plant components under the direction of the Start-up Engineer. Wherever and to the greatest extent possible, these operators should be those who will ultimately operate the new installation, for this is an excellent period with ideal conditions for personnel training.

Finally, the same conference between Construction and Operating management groups should iron out the details necessary to assign the required construction craftsmen to the preliminary operations group. Given proper publicity throughout both groups, this should completely eliminate later disputes over which group will perform certain jobs. The plant operators will operate all valves and machinery. The construction workers will make all repairs, correct leaks and perform such maintenance as may be necessary until the plant is finally turned over to the operators for commercial operation.

Preparing the Schedule

To hold duplication of effort and attendant wasted motion to a minimum will require a great amount of planning and scheduling on the part of those in charge of preliminary operation. Obviously, little is achieved if the condensate system downstream from the condensate pump is flushed before the condensate pumps are run in, for the running-in of the pumps will accomplish this operation all over again.

Certainly the pumps cannot be run-in until the condenser has been inspected and flushed clean and no one would expect to flush the condenser until it had been subjected to a hydrostatic test of its flanged connection to the turbine exhaust and its tube sheets.

The foregoing is used to point out the extreme importance of planning the proper sequence of operations. While this sequence may vary with different installations, there are certain operations that will hold true for the great majority of plants and it is intended that subsequent articles in this series will be presented much in the order that the operations would normally occur in this great majority of plants.

Finally, and before the actual work of preparing the new plant for operation begins, each member of the start-up team should be made to realize that four major considerations affect the ultimate operation of the plant. These, in the order of their importance, are:

1. Safety of Personnel
2. Safety of Equipment
3. Availability of Equipment
4. Efficiency of Equipment

How To Clean Auxiliary Piping

Of paramount importance in the readying of the new steam plant for initial operation is the systematic and meticulous cleaning of all auxiliary piping. By far the most common operational difficulty experienced in starting new installations stems directly from laxity or outright neglect in the cleaning of new piping systems preparatory to the actual start-up.

Few occasions give a greater sense of frustration than that experienced in having to shut down a new multi-million dollar plant due to inability to get cooling water to a lube oil cooler, or to the bearings of a boiler feed pump or fan, or because compressed air lines to the control instruments become clogged. The time to preclude the possibility of such failures is well in advance of the start-up date and preferably as soon as the various lines are completed and released by the construction forces.

To present an orderly sequence of

*Power Engineer, United Engineers & Constructors, Inc

Fig. 1. Preliminary operation begins at unique unit 5, Rio Grande Station

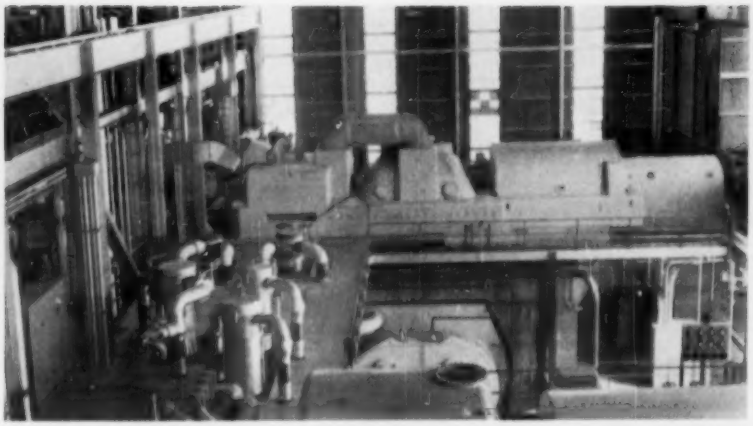


Fig. 2. Turbine-generator at Hookers Point Station, Tampa Electric Co, nearly ready to go. This is stage when constructor's start-up engineer goes to work

operation, only the cooling water and compressed air systems will be considered at this time. The cleaning of condensate and boiler feed water piping is a much more involved procedure and will be treated later.

Cooling Water Systems

Procedures will vary with water sources. In those systems utilizing make-up from a municipal source, a cooling water head tank is usually installed and this should be cleaned and inspected. Preservatives applied by the manufacturer should be removed by wire brushing.

The flanged connection at the cooling water pump suction can now be sprung apart and that portion of the system from the head tank to the pump flushed thoroughly. To obtain the benefit of mass velocity flow, the head tank should be filled by valving off the suction line and then emptied through a wide open valve.

This same procedure will be repeated until clear water, free of welding beads and other debris, issues forth at the sprung flanges ahead of the cooling water pump. Install a flat 8-mesh strainer with soft sheet gaskets on either side between the pump suction flanges and make up the joint for service. In cooling water systems with a relatively clean source of supply, this strainer will be necessary for the preliminary phase of operation only. It should be considered a permanent installation in systems using water from a lake, river or any other source where marine life or transient debris is a problem, and in such cases should be made of corrosion resistant material.

With all branch lines feeding from the cooling water main valved off, pressurize the main with the cooling water pump and flush to sewer through the valve furthest from the pump in the main proper. Continue the flushing process by alternately opening and closing this valve until a clear discharge indicates that the main is clean.

Each cooling water branch line will now be flushed clean, with the pipe unions in the line ahead of each piece of equipment being broken until the branch line effluent runs clear and clean.

All unions should be left unmade until the branch lines have been flushed clean, after which all unions will be reconnected and the equipment cooling boxes and the cooling water return line flushed as a unit up to the cooling water heat exchanger, if such is installed.

The entire cooling water system should be left in a flooded condition. Small additions of sodium sulfite to the system in quantities sufficient to give a 5-ppm sulfite residual to the cooling water will aid materially in reducing oxygen corrosion in the system and keep flow indicator sight glasses clean.

Compressed Air Systems

The compressed air system is cleaned in an operation quite similar to that used in cleaning the cooling system, with the exception that compressed air, rather than water, is the cleaning medium and the air lines are blown free of debris. The flushing of compressed air lines is not recommended due to the extreme difficulty experienced in later clearing the system of moisture with its attendant invitation to corrosion attack.

The compressed air receiver should first be thoroughly cleaned and inspected and the system blown out in incremental sections. This can most easily be accomplished by timing the operation to coincide with the run-in period of new compressing equipment, which will be discussed in a later article.

HERE IS the second of a group of related articles covering the various operations necessary to get a new steam-electric power station ready for commercial operation.

The author is an expert in start-ups; that's his principal job. So he is writing on the following steps required to start up a new plant:

Cleaning of Auxiliary Piping

Inspecting, Cleaning and Testing of Tanks, Condenser and Feed Water Heaters

Running in Rotating Equipment

Cleaning the Boiler Feed Water System

Sore Spots to Avoid in the Circulating Water System

Checking, Testing and Pre-setting Instrumentation and Controls

The Boiler

- **A. Hydrostatic Test**
- **B. Boil out and Acid Wash**
- **C. Setting Relief Valves**

Blowing Steam Lines

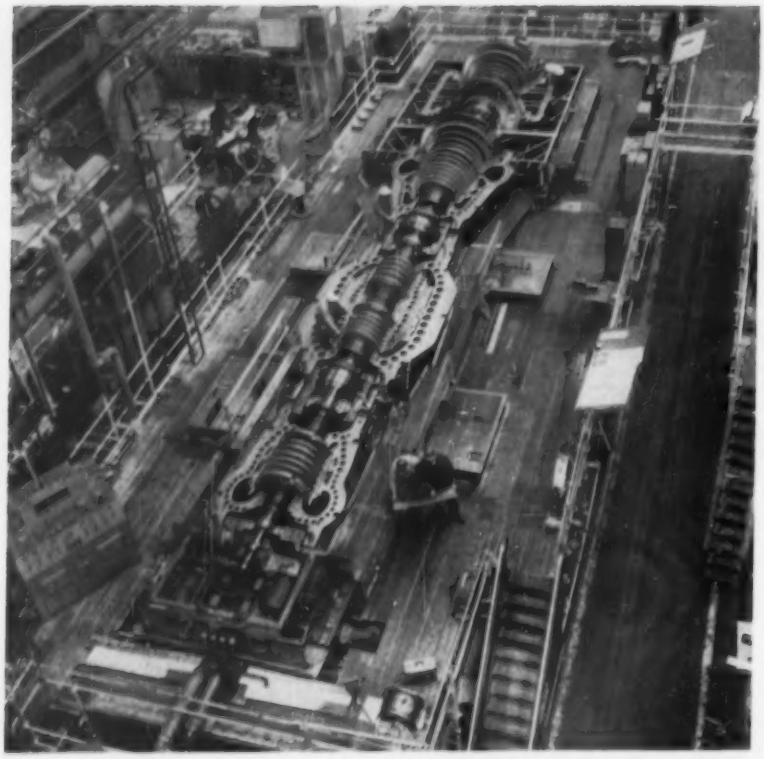
The Turbine

- **A. Hydrostatic Test of Hydrogen and Lube Oil Coolers**
- **B. Air Test of Hydrogen Cooling System**
- **C. Oil Flush**

Preliminary Operation

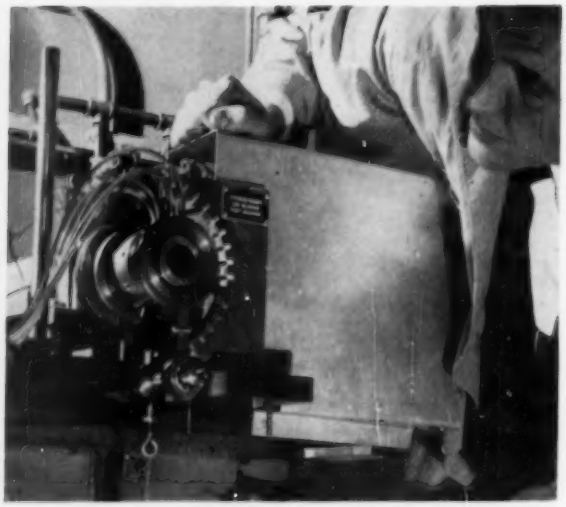
Perhaps this unusual and practical series will ultimately result in a book. Both the author and the editors will welcome your comments on the idea of this series and on the individual articles as they appear.

POWER ENGINEERING'S *NEWS REEL*



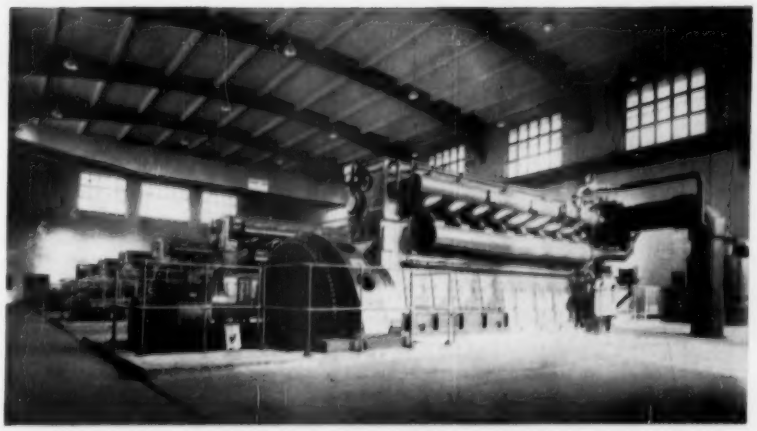
Turbine on half-shell is GE's apt term for this photo of world's largest extraction steam turbine being built for N. J. Public Service Electric and Gas Co's Linden plant. Having largest steam flow of any turbine in existence, it will handle 2,800,000 lb of steam per hour and play part in swap of steam for oil with Esso Bayway Refinery

Simulator (below, left) trains General Electric inspectors to use ultrasonic rotor inspection equipment. Metal particles suspended in glycerine give appearance of rotor flaws on detector screen; inspectors learn to recognize and locate various types of defects



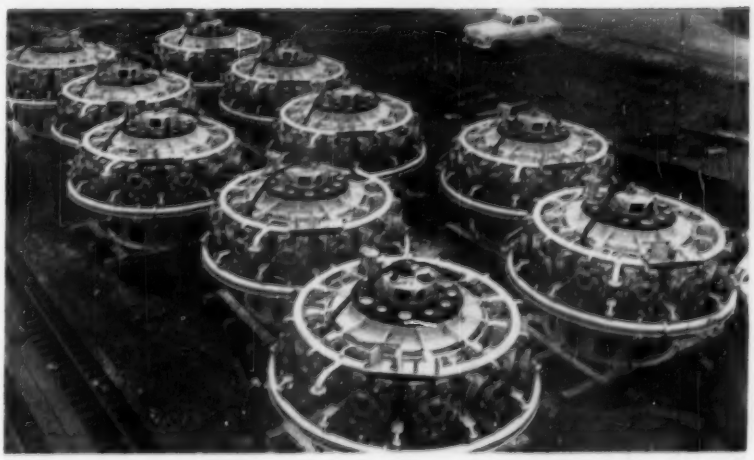
Air-lubricated bearing (above) in a testing device at GE's new bearing laboratory. Hydrodynamic air bearing has been developed for special applications such as extremely high temperatures, radioactive areas, or where very low friction is a must. But don't expect to drive into your service station soon and order: "Change the air in the crankcase, please." Chances are oil will still be with us next year

Nine-foot fan (above), built by Westinghouse for Philo plant of the American Gas & Electric Co in Ohio, is capable of handling gases at 850 F at top speed of 25,000 ft per minute. Design had to accommodate ⅝-in. expansion up to operating temperature

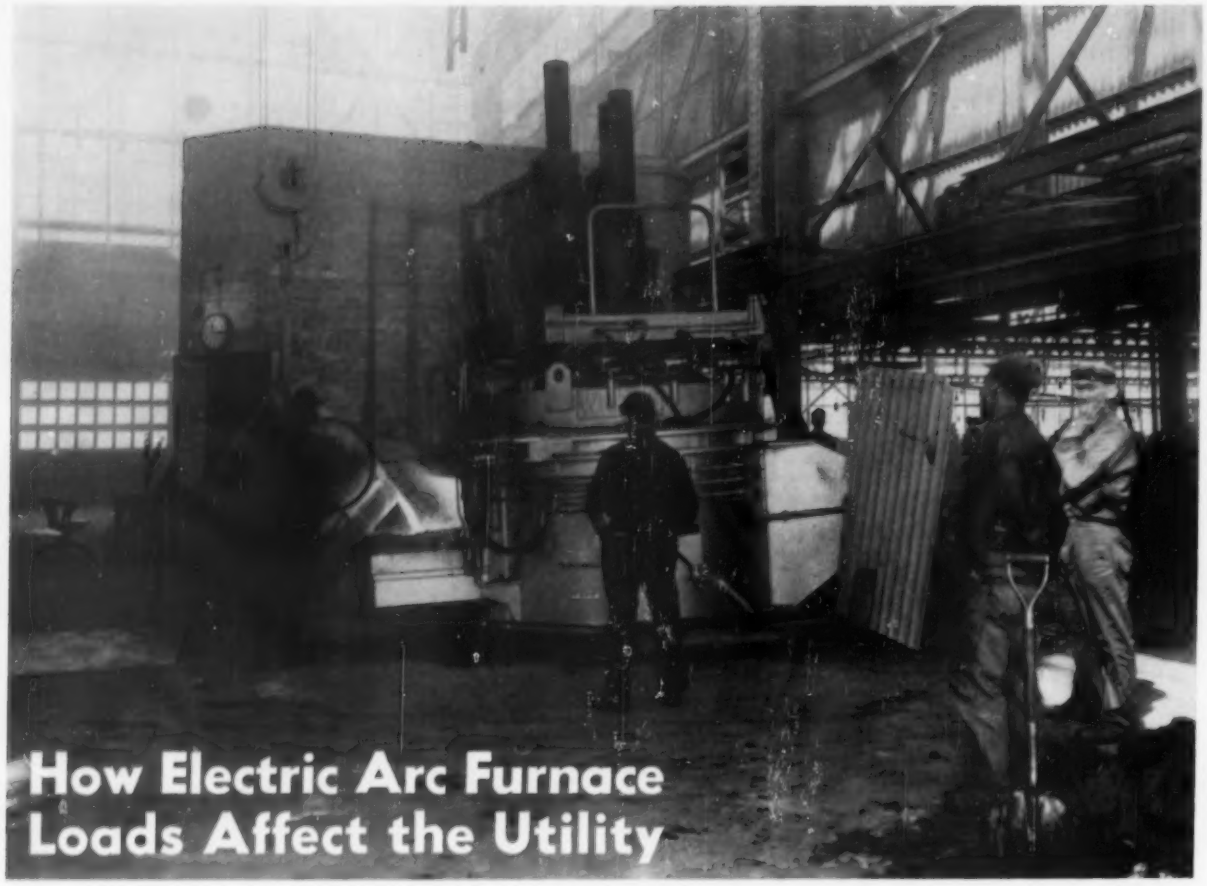


Fooled by picture of drilling rig? (Above, right) We had to take second look before we noticed it was artist's drawing, not a photograph. Two 850-hp Alco diesels supply all power for offshore mobile rig in Gulf of Mexico

Power from sewage (right, center) is generated at New York's Owl Head Sewage Treatment Plant. Officials claim generating own power from sewage gas with six Superior diesels is saving city almost $62,000 a year



Ready and waiting (right) are 10 new Nordberg radial diesels at dockside in Milwaukee; already factory assembled, they were shipped to Alcoa's expanding Point Comfort reduction plant where 220 similar units provide capacity of over 400,000 hp



How Electric Arc Furnace Loads Affect the Utility

This article will help the owners and operators of electric arc furnaces understand how the peculiar characteristics of their equipment increase the cost of generating and distributing electric power

By CHARLES W. VOKAC *

THE ELECTRIC arc furnace has become a significant part of our economy today. Electric furnaces can melt anything found in the earth's crust which can be reduced to a molten state, and can then process these melted materials.

Electricity is the one *perfect fuel;* it has none of the contaminating elements present in such fuels as coal or gas which often change the character of the molten metal. Moreover, less expensive raw materials can be used because of the precise metallurgical control possible with arc furnaces.

These and other important advantages have made these units indispensable to many foundries. At the same time, the power supplier looks upon the electric arc furnace load as an attractive one from the kilowatt-hour standpoint. However, this same load has a low power factor, a low load factor, and is changed frequently and suddenly.

How these objectionable qualities increase the cost of power generation and distribution is not understood by most arc furnace owners. Overlooked is the fact that the power supplier must have on hand at all times the facilities and equipment necessary to supply the large quantities of power needed by the furnace — even though the unit is actually operating only part of the time.

The power supplier must naturally seek reimbursement for the equipment needed to supply a safe margin of operation, and a factor is required for this reimbursement. Though it cannot be evaluated as conveniently as the load or power factor, its effect can be estimated and taken into account when a power schedule is calculated for a furnace user.

Since the amount of electricity used by a furnace owner — and hence the cost of operation — varies directly with the way in which the furnace is used, it becomes essential that efficient control be maintained always. Naturally, good control is also reflected in product quality.

The arc furnace circuit is highly reactive. When the furnace is properly designed, practically all circuit resistance is in the arc only. Since arc current values are in the thousands of amperes, considerable inductive reactance is developed, particularly in the arc current conductors. It is not, however, entirely wasted.

In fact, when the inherent circuit impedance beyond the arc is less than about 50 per cent as is the case with smaller furnaces, supplemental reactance is added to stabilize the arc.

The resistance of the arc is dependent upon the length of the arc gap and upon the conductivity of the arc plasma. In turn, arc plasma conductivity is dependent upon its constitution and temperature. All these conditions must be in perfect balance. Any change in any one of them will lead to the destruction of the arc in increasing moments, unless a counteracting moment is applied.

Reactance is one of these, and how it counteracts the effects of arc changes is shown in Fig. 1. The reactor X_L represents the total reactance in the circuit. The transformer primary is represented by P and its

* Manager, Electric Furnace Division, Whiting Corporation

secondary by S. E is the electrode, A is the arc, and the charge is C, grounded at G. The applied line voltage is shown by V_1 and the drop in voltage across the reactor by V_2. The difference between V_1 and V_2 is V_3 and represents the voltage left for the transformer to produce an arc voltage.

Because it is considered ahead of the reactance, V_1 can be assumed to be constant for all practical purposes. V_2 across the reactor will vary directly with the current in the reactor. If there is too little or no reactance, the arc current will instantly go down to zero or up to short circuit at the slightest disturbance. In either instance, the arc will be extinguished.

An arc is different from any other resistor in that it changes its cross section automatically — from thick to thin when the current in it is reduced, and from thin to thick when the current in it is increased. When thin, its resistance to current flow is high; when thick, its resistance is low.

If there were little or no reactance in the circuit, V_3 would be equal to V_1 at all times. However, the arc length, without electrode repositioning, will not remain constant or near constant in the furnace. The electrode will burn away or the charge will melt or fall away, increasing the arc length. The charge may shift toward the electrode, decreasing arc length. A wave of metal passing under the electrode will increase and decrease the arc length.

In any case, the required arc length must be restored to keep the furnace operating at its highest point of efficiency and to prevent eventual arc extinction. This is accomplished by moving the electrode up or down in response to the unbalanced condition. How well it is done depends upon how quickly the arc furnace control can restore and maintain the required arc length.

Through the years, various methods of electrode positioning have been employed — manual as well as mechanical. One in wide use today and which has proved to be most efficient is shown in Fig. 2.

Its electrode motor M_1 is energized directly upon a signal from the bus. Thus, the signal itself is the motivating force and no time is lost getting the signal to the electrode motor. Both motors are unidirectional; do

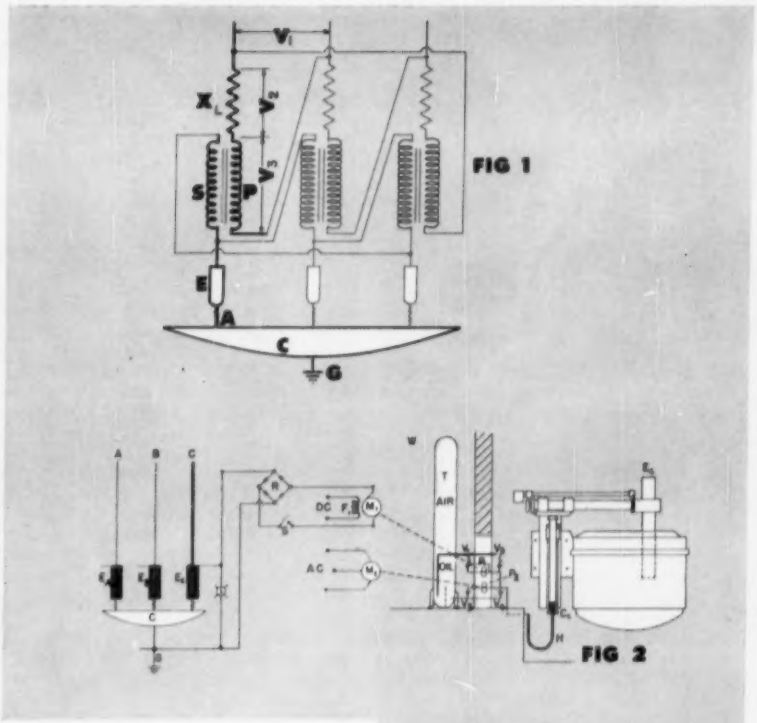


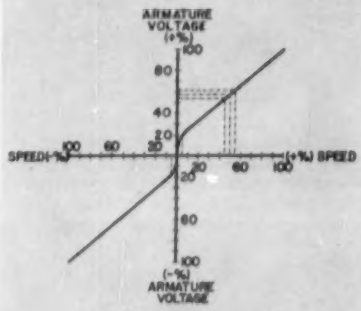
Fig. 1. Typical arc furnace circuit. High reactance of this type of circuit counteracts the effect of arc changes and helps to maintain both arc and furnace stability

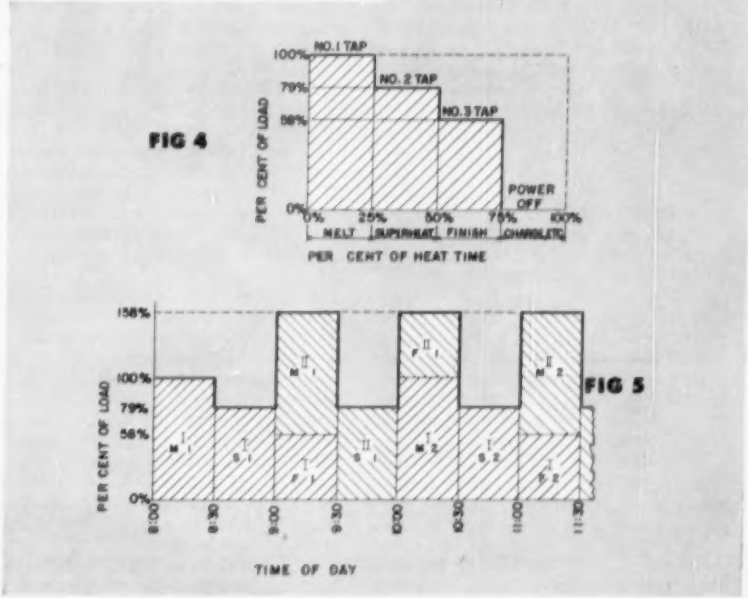
Fig. 2. Diagram shows one widely used method of electrode positioning. Object of positioning control is to maintain required arc length for max furnace efficiency

Fig. 3. Relation between speed and voltage applied across its armature for a typical electrode motor, shunt d-c, with 100 per cent constant field excitation

Fig. 4. Simplified load curve for a single electric arc furnace showing variation of load during the heating cycle. Highest load factor for this cycle is 59 per cent

Fig. 5. Load curve demand of two furnaces. Roman numeral identifies furnace, letter transcript the part of the cycle and Arabic number gives number of the heat





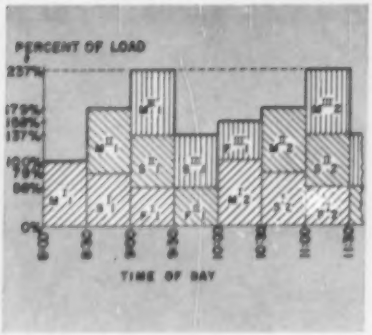


Fig. 6. Load curve showing demand of three furnaces. Meaning of letters and subscripts explained in Fig. 5 caption

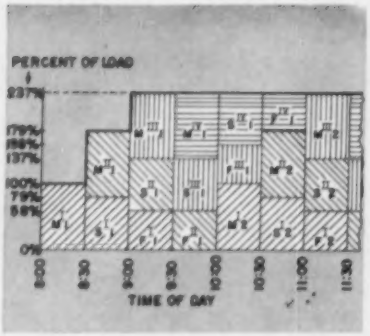


Fig. 7. Load curve showing demand of four furnaces. Notice how operation of several furnaces evens out the load

OPERATION	NO. OF FURNACES	LOAD FACTOR	DAY DEMAND %	TOTAL CONNECTED LOAD	SURGE FACTOR % OF TOTAL CONNECTED LOAD SINGLE PHASE	3 PHASE
8 HOURS PER DAY 5 DAYS PER WEEK 50 WEEKS PER YEAR	1	13½%	100%	100%	116%	200%
	2	17%	158%	200%	91%	(184%)
	3	17%	237%	300%	91%	(184%)
	4	23%	237%	400%	68%	(116%)
24 HOURS PER DAY 7 DAYS PER WEEK 52 WEEKS PER YEAR	1	58%	100%	100%	116%	200%
	2	75%	158%	200%	91%	(158%)
	3	75%	237%	300%	91%	(158%)
	4	100%	237%	400%	68%	(116%)

Fig. 8. Tabulation of operation of all four units. The figures in parentheses are possible, but unlikely, occurrences

not reverse to reverse the electrode.

Motor M_2 is connected directly to pump P_2 which pumps liquid from the tank T at a constant measured rate to the cylinder C_e. Motor M_1 is connected directly to pump P_1 and it pumps the liquid away from the cylinder C_e, returning it to tank T. When the motors are running at the same relative speed, pump P_1 returns all the output of pump P_2 and the electrode holds the proper arc length. When Motor M_1 speeds up or slows down according to the amount the arc is off balance, the difference in the output of the pumps either raises or lowers the electrode.

This control effects only a light contact between the electrode and the charge and not a bolted short circuit. This establishes a resistance which impedes the initial current flow instantly. The surge is thus further reduced below the value established by the reactance harness.

Electrode Speeds

The control also practically anticipates the initial inrush current. The electrode goes down, touches the charge, and instantly retracts whether the current has begun to flow or not. It does not wait for the current signal to tell it to go back. Electrode speeds of 10 feet per minute are practical with this dynamic control because compatible electrode response and acceleration are obtainable. This means that the duration of the surge is also reduced.

Figure 3 shows a voltage versus speed characteristic of an electrode motor (d-c, shunt wound, with 100 per cent constant field excitation). The relation between the speed of the motor and the voltage applied across its armature is practically linear above about 13 per cent of its speed. Below 13 per cent, motor speed drops because of inherent losses in the motor.

The dynamic arc furnace control using non-reversing electrode motors establishes a neutral point at +50, +58. From this point, only a 9 per cent change in armature voltage is required to produce the 10 per cent electrode speed regulation. This contrasts sharply with the 40 per cent change in armature voltage required for the same electrode regulation when reversing motors are used. Also, the inherent motor losses are made up at once and they are then carried along as long as the control is in operation.

At the neutral point, motor M_1 and pump P_1 (Fig. 2) are running at only half speed; motor M_2 and pump P_2 (which is half the size of pump P_1) are running at full speed in the opposite sense. Thus, the electrode remains motionless holding the proper arc length at this point. The slightest change in the armature voltage of motor M_1 — upward or downward — will result in a proportional change in the electrode speed, downward or upward respectively.

When the arc furnace is used for duplexing or smelting, the load is fairly continuous and constant. It is when the furnace is used for batch melting that the load is most irregular.

Batch Melting

When the furnace is charged with cold scrap and the power is turned on, the electrodes bore a hole through the scrap rather quickly and draw arcs upon the pool of molten metal formed at the bottom of the furnace. Radiant heat from the arc and the heat of the pool melt down the rest of the scrap. Since the cold scrap envelops the arcs, long arcs — high arc voltages — are desirable to produce more heat with the same current and more heat to melt the scrap down quickly.

After the scrap is melted down, the radiant heat must be reduced or the roof and sidewall refractories will become overheated before the metal bath becomes superheated. The operator, therefore, selects a lower voltage on which to run the furnace until the heat is up to the required temperature for metallurgical manipulations, or until the refractory is up to critical temperature. The operator then switches to a still lower voltage to finish the heat.

The total time for the heat may vary from one hour on upward depending upon the size of the heat, the type of scrap used, the size of the furnace transformer, and the type of metal produced. A heat is represented by the simplified load curve in Fig. 4. The full load is used to melt down the cold charge and is cut back to about 79 per cent to superheat the charge. The heat is finished on about 58 per cent power and poured out of the furnace. The furnace is then prepared for the next heat, charged, and put back on the line to start the next cycle. Time intervals between cycles may vary also.

For a furnace operating 24 hours a day, 7 days a week, 52 weeks a year in this way, the load factor shown by the shaded area would be only 59 per cent. Operating 8 hours a day, 5 days a week, and 50 weeks a year, the load factor drops to 13.5 per cent.

Figure 5 shows the demand of 2 furnaces. The furnaces are identified by the Roman numerals, the part of the heat cycle by the letter subscript, and the number of the heat by the Arabic numerals. Thus, $_{M}II_1$ means No. II furnace is melting its first heat. Fig. 6 shows 3 furnaces and Fig. 7 shows 4.

Figure 8 is a tabulation of the operation of all 4 units. The figures in the first 5 columns are self-explanatory. The figures in parentheses are calculated possible occurrences, but are so remote if adjusted by probability that they are not of any practical significance.

Even the surge factors not in parentheses are conservative, particularly for the multiple furnaces. For example, the 68 per cent single phase value presupposes that 8 electrodes on the 4 furnaces, all on the same phase at the same instant, are all solidly grounded on the charge. With the dynamic arc furnace control, it is a very remote possibility that even 2 electrodes in one furnace will become solidly grounded at the same instant. Thus, the power engineer may use even the 116 per cent single-phase values and the 200 per cent three-phase values with assurance of the same conservatism characterizing the excellent service of the power and telephone industries in this country.

Annual ASME Meeting and Power Show —New York, November 1956

POWER SHOW

Returning to New York City and to the new Coliseum, the 1956 Power Show (above and right) attracted 30,000 attendance. Of the 8000 engineers attending the Annual ASME Meeting, some 3000 registered for the Power Show. Features of the Show: Nuclear power models; free-piston machine; package steam generators; new metals and materials to meet the requirements of the future

ASME MEETING

Retiring ASME President Joseph W. Barker (left), incoming 1957 President William F. Ryan (far right) greet new honorary members Wm. F. Gibbs, S. C. Hollister, C. W. E. Clarke

At ASME session on Eddystone 5000-psi power plant (l to r), J. H. Harlow, Phila Elec Co; C. C. Franck, Sr, Westinghouse; E. M. Powell, Combustion Engineering, discuss papers they delivered on general design, turbine and steam generator

Standing room only, as 1000 or more engineers crowded the two ASME sessions on atomic power plants to hear details of Indian Point, Consumers Power District, Penna P&L Co, Yankee, Dresden, Enrico Fermi atomic power plants, being planned at present for construction in the near future

Here's Practical Method of Power

DAILY OPERATION SUMMARY	#1 Turb-Gen, #1 and #2 Boiler			#2 Turb-Gen, #3 Boiler		
	TODAY	TO DATE THIS MONTH	THIS MONTH LAST YEAR	TODAY	TO DATE THIS MONTH	THIS MONTH LAST YEAR
Average gross generation, kw	44,700	42,000	53,100	102,600	98,200	96,500
Maximum hour generation, kw	61,200	65,900	64,300	112,200	114,100	111,700
Minimum hour generation, kw	30,600	26,200	33,200	88,900	72,800	75,900
Main steam pressure, psig	1231	1235	1252	1805	1802	1790
Main steam temperature, F	942	940	948	980	985	993
Reheat steam temperature, F	—	—	—	1008	1002	990
Steam rate, lb/kwh gross	8.32	8.30	7.95	6.44	6.51	6.48
Exhaust pressure, in. Hg abs	1.12	1.10	1.10	1.02	0.98	0.95
Condenser cross temperature, F	13	13	12	11	12	11
Condenser air leakage, cfm	8	7	3	7	7	8
Feedwater to economizer, F	365	363	370	442	440	444
Excess air, per cent	#1 28 #2 30	#1 27 #2 27	#1 26 #2 25	22	23	26
Flue gas temperature, F	#1 360 #2 370	#1 370 #2 370	#1 340 #2 340	290	298	300
Spray water flow, 1000 lb/hr	#1 16 #2 18	#1 6.4 #2 30	#1 21 #2 0	12.7	8.8	6.5
	STATION			OPERATION NOTES:		
	TODAY	TO DATE THIS MONTH	THIS MONTH LAST YEAR	(Remarks on occurrences which affect efficiency -- feedwater heaters out of service, number of circulating water pumps on, condenser backwash, etc.)		
Air to forced draft fans, F	58	61	60			
Cooling water to condensers, F	43	44	43			
Auxiliary power, per cent	6.61	6.55	6.12			
Make-up water, per cent	1.70	1.66	0.95			
Heat rate, Btu/kwh net	—	9760	9680			

Illustration shows how typical daily operation summary sheet may be made to establish basis for analyzing plant efficiency

Table I. Chart shown is a typical example of expected performance sheet; these design values for various conditions assist in analyzing summaries

	#1 Unit (60mw)				#2 Unit (100mw)			
Load	15mw	30mw	45mw	60mw	25mw	50mw	75mw	100mw
Steam rate at 1-in. Hg	8.81	8.06	7.91	8.10	7.52	6.97	6.55	6.46
Steam rate at 1½-in. "	9.10	8.27	8.03	8.21	7.80	7.18	6.68	6.55
Steam rate at 2-in. "	9.41	8.43	8.24	8.30	8.12	7.37	6.79	6.67
Feedwater temp, F	285	345	374	397	335	380	425	450
Condenser cross temp	5.5	9.0	12.5	16.0	3.5	6.0	8.5	11.0
Flue gas temp, F	318	335	346	350	270	280	292	303
Main steam temp, F	860	930	950	950	870	980	1000	1000
Reheat steam temp, F	—	—	—	—	910	1000	1000	1000
Main steam pressure	1250	1250	1250	1250	1800	1800	1800	1800
Per cent excess air	25	23	23	23	24	21	21	21

Table II. Suggested schedule for minimum test program only; select actual program to suit

Equipment	Type of test	Frequency
Boiler	Coal fineness	2 weeks to 1 month
	Per cent combustible in ash	1 to 2 months
	Air leakage by CO_2 at furnace outlet, economizer outlet, and air heater outlet.	1 year
Turbine	Stage pressures and load at fixed valve position.	1 year
Feedwater Heaters	Terminal difference and drain cooler temperature difference.	1 year

Plant Performance Control

Determining efficiency of their operation is constant concern of power engineers, especially in smaller plants without the man-power and test instrumentation available in large central stations. Here's a practical program that will help you control your day-to-day operating performance

By C. B. SCHUDER *

AFTER STEAM POWER plant equipment has met manufacturer's guarantee through initial acceptance tests, the operator's problem becomes one of maintaining this guarantee efficiency in day-to-day operation. Complete, up-to-date, and accurate measurement of equipment performance is available only in the largest central stations. Other stations facing limitations in manpower and test instrumentation must resort to some sort of a modified program which can be maintained at a minimum overall cost. Such a program involves: first, summarizing the critical items from the daily operating records in a form which will encourage analysis and correction, and second, conducting a selective equipment test program with a minimum of manpower and instrumentation.

Keeping a plant at top efficiency involves two basically different methods of approach:

1. **Day-to-Day Control:** Maintaining operating variables which are under control of the operator at values which are found to result in minimum overall operating costs.
2. **Long-Term Control:** Detecting and correcting equipment efficiency losses resulting from wear, corrosion, and deposits.

Operation Summary Sheet

Daily operating logs, as usually summarized to show total steam production, net and gross power outputs, etc., combined with the instrument charts, provide sufficient information for performance analysis — but in a form that requires considerable time for interpretation. Totals, such as *total steam produced*, may be desirable from an accounting standpoint, but their inclusion on a daily operation summary only complicates the summary and discourages proper use of the report by key supervisory personnel.

A practical daily operation summary sheet should include only those items which either affect, or accurately reflect, changes in plant efficiency. This would include certain pressures and temperatures which are under control of the operator, and other factors such as air temperature, cooling water temperature, and average power loads. Items such as heat rate, pounds of coal per kwh, and pounds of steam per pound of coal, either lack significance or are not normally accurate enough on a day-to-day basis to justify space on the summary sheet. Water or steam rate are desirable items if metering is consistent (even though inaccurate), although the terms themselves are not always a direct efficiency indication.

Every item appearing on a daily operation summary should be of such definite significance and unquestionable reliability that when a day-to-day variation is noted, it will receive immediate attention and correction.

The illustration shows a typical operation summary sheet. Note, for example, that barometric pressure and vacuum have been omitted and only the significant item, turbine exhaust pressure, retained. Heat rate on a day-to-day basis is unreliable but can be fairly accurate on a *this month to date* basis after the first few days of the month. Per cent make-up and auxiliary power can rarely be reported satisfactorily on a unit basis due to water interconnections and power supplies to common service equipment. If trouble appears on a station basis, however, units can be isolated and checked separately.

Watch Boiler Performance

Boiler performance is watched by means of the two critical items — excess air and flue gas temperature. Efficiency changes will be detected here more readily and accurately than by pounds of steam produced per pound of coal.

The same general approach is used on the turbine where the major day-to-day problem is not detection of long term deterioration but maintaining design pressure and temperature and avoiding unnecessary time at low loads.

Condenser cleanliness is monitored by cooling water temperature rise, and most other losses as unnecessary lighting, poor use of service equipment, feedwater system leakage, excessive boiler blowdown, etc., will show up as an increase in the percentage of auxiliary power or make-up.

No effort is made to summarize the feedwater heater system daily except for the top heater, which is the most critical one from an efficiency standpoint.

To assist in the interpretation of summary sheets of this type it may be found desirable to prepare an *expected performance* sheet as shown in Table I showing design values for different loads and back pressures.

This day-to-day checking program will help keep operating procedures at a point of maximum efficiency, but, in general, will not be an adequate indication of equipment deterioration. This is partly due to lack of completeness and accuracy of station instrumentation but also due to lack of a constant load over the 24-hour period on which to base performance measurements.

Test Program

To round out a performance program, then, it is necessary to conduct a certain amount of periodic test work. The extent of test work that can be economically justified will naturally vary from plant to plant. Table II gives a suggested minimum program for the average station.

The important point in a test program is to select a group of tests that can be conducted with a very high degree of reliability. This will, as a rule, eliminate tests involving flow measurement because of the difficulty in maintaining up-to-date calibration of primary flow elements.

For example, a periodic turbine heat rate test would be very desirable but few plants have the precision test equipment that is necessary for the required accuracy. The results of such a test, with station instruments, would not, in general, be indicative of changes in turbine condition. The most common cause of loss of turbine efficiency is blade deposits, so a test designed to detect such trouble is the most logical approach for the average plant. This type of test can be satisfactorily handled without flow measurement by accurately noting load and stage pressures at some exact valve position. Operating pressures and temperatures along with feedwater system condition must, of course, be identical from one test to another.

Other equipment tests can be designed along this same line to avoid unusual demands for men and test equipment, but still retain final accuracy of results.

Tests to measure turbine leak-off, pump performance, pulverizer power, fan characteristics, condenser heat transfer, and many other performance items may be justified in certain cases. The important point, whether in test work or in operation summaries, is to consider only those items that are significant performance indications, and that can be measured accurately.

*Staff, Purdue University

How Standby Diesel Sets Fit into Caterpillar's Electric System

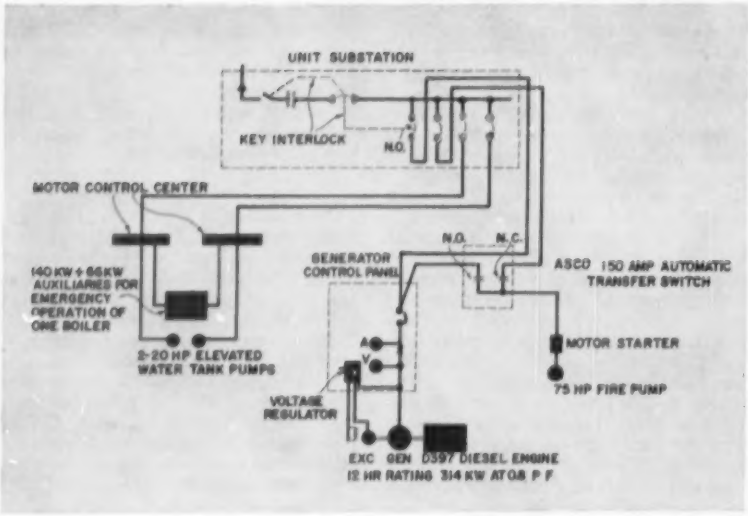


Fig. 1. Schematic diagram of standby power for emergency circuits located in the boiler plant. Emergency power is supplied by a 315 kw diesel electric generator

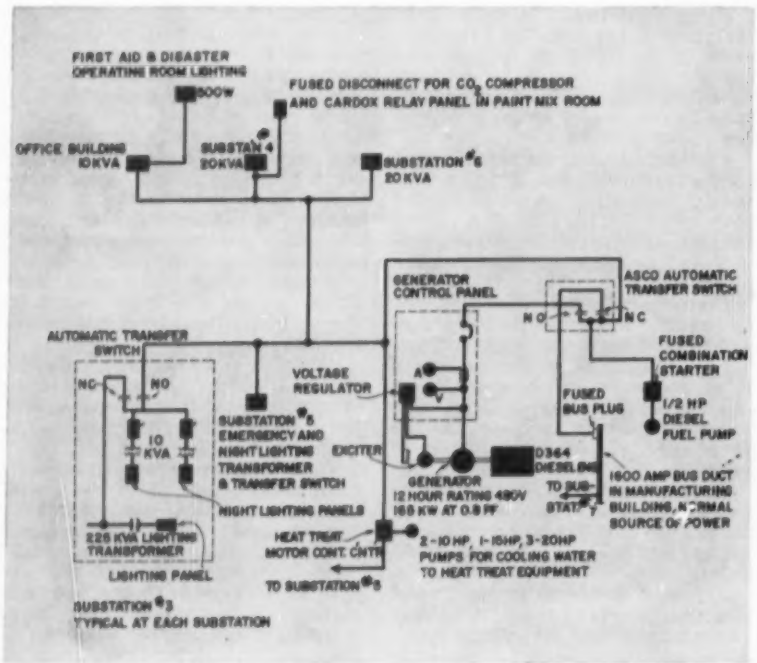

FIRST AID & DISASTER OPERATING ROOM LIGHTING
500W
FUSED DISCONNECT FOR CO2 COMPRESSOR AND CARDOX RELAY PANEL IN PAINT MIX ROOM
OFFICE BUILDING 10KVA
SUBSTATION #4 20KVA
SUBSTATION #6 20 KVA
GENERATOR CONTROL PANEL
ASCO AUTOMATIC TRANSFER SWITCH
N.O.
N.C.
AUTOMATIC TRANSFER SWITCH
N.C.
N.O.
VOLTAGE REGULATOR
A
V
FUSED COMBINATION STARTER
FUSED BUS PLUG
1/2 HP DIESEL FUEL PUMP
SUBSTATION #5 EMERGENCY AND NIGHT LIGHTING TRANSFORMER & TRANSFER SWITCH
10 KVA
EXCITER
D364 DIESEL ENG
GENERATOR 12 HOUR RATING 480V 165 KW AT 0.8 PF
TO SUB-STATION #7
1600 AMP BUS DUCT IN MANUFACTURING BUILDING, NORMAL SOURCE OF POWER
NIGHT LIGHTING PANELS
225 KVA LIGHTING TRANSFORMER
LIGHTING PANEL
HEAT TREAT MOTOR CONT. CNTR
2-10 HP, 1-15HP, 3-20HP PUMPS FOR COOLING WATER TO HEAT TREAT EQUIPMENT
TO SUBSTATION #5
SUBSTATION #3 TYPICAL AT EACH SUBSTATION

Fig. 2. Schematic diagram of standby power circuits for emergency night lights, heat treating furnaces and fire protection system, provided by 165 kw diesel set

By C. R. GALBREATH *

MILLIONS OF DOLLARS worth of plant equipment, thousands of workers' lives and the continued output of the world's largest motor grader and wheel tractor factory are safeguarded by 2 big diesel-electric sets installed in new Decatur, Illinois, plant.

When the new plant was still in the planning stages, it was realized that an unexpected power failure could mean far more than an unscheduled work stoppage.

If power were lost in the boiler room, for example, the induced and forced draft fans would stop, and the boilers might suffer severe damage from overheating. Loss of steam in winter could permit pipes throughout the plant to freeze and burst. In addition, make-up water would no longer be supplied to the boilers by the feed pumps, creating a dangerous explosion hazard.

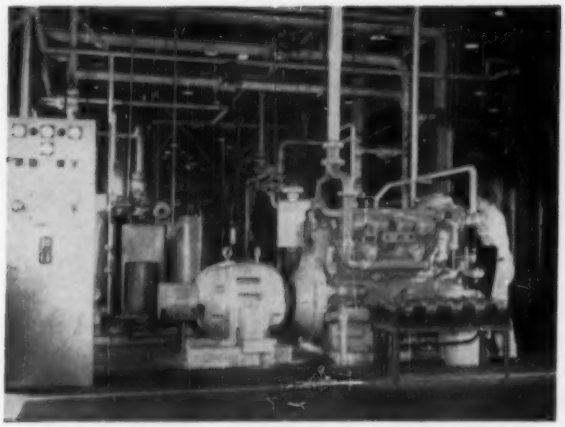
Heat treating equipment must have adequate water from hot and cold wells to keep doors from warping and bearings from burning. Emergency power must also be provided for conveyor equipment to keep parts in process from being lost.

A certain amount of fire fighting and emergency lighting equipment must also have dependable power at all times. Pressure in the automatic Cardox CO_2 system installed in the large conveyer-equipped paint spraying booths and the paint mix room is maintained by a compressor, which in turn is connected to the emergency power system by an automatic transfer switch. A sure supply of water for fighting fires in other parts of the plant is provided by a fire pump, which is also connected to the emergency power system.

Emergency night-lighting circuits have been provided, engineered to provide an average of 2 to 3 ft-candles of illumination in shop areas and office aisles, 5 to 10 ft-candles on stairways and 50 ft-candles in the emergency operating room of the Medical Center.

Power for such plant protection services as fire alarms, valves on fire protection mains, fire and watch stations and the plant telephone

*Plant Engineer, Caterpillar Tractor Co, Decatur



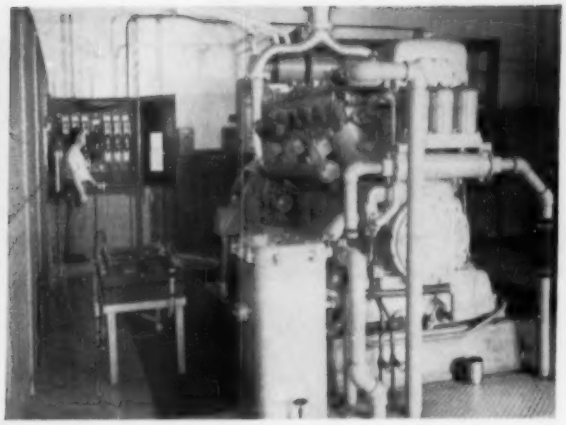


Fig. 3. Above: This 165 kw diesel-electric set provides emergency power for heat treatment equipment, emergency night lights and CO_2 fire protection in the paint mix rooms

Fig. 4. Above right: Automatic transfer switches start 315 kw diesel electric set within six seconds after a power failure. This set can shut the boilers down or run one at full load

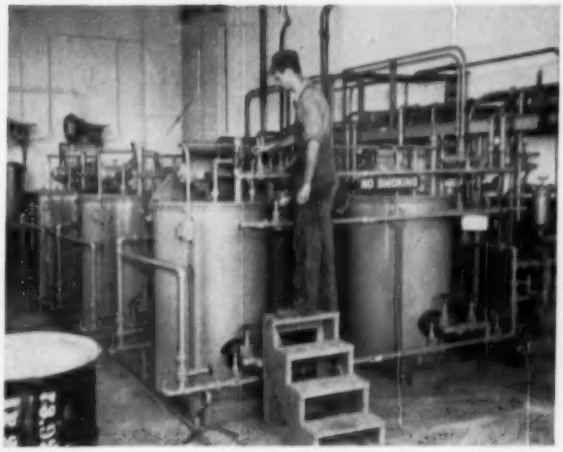


Fig. 5. Cardox fire protection system capable of producing a 30 per cent CO_2 atmosphere installed in paint room. Power to maintain pressure supplied by diesel-electric set

system is provided by storage batteries capable of operating this equipment for over 12 hr without recharging. If a power outage should last longer than 12 hr, as might occur in a major natural disaster or enemy attack, the trickle charger used to keep the batteries charged could be quickly and easily connected to the emergency power system.

Standby power for the emergency circuits located in the boiler plant (see Fig. 1) is provided by a diesel electric set equipped with an externally-regulated, 60-cycle, 3-phase, 1200-rpm generator capable of producing 315 kw continuously at 240–480 v at 0.8 power factor. Switchgear is floor standing type, with a dead front panel mounting for instruments, controls, voltage regulator and circuit breaker. A transfer switch with 0-30 minute adjustable time delay on restoration of normal source of supply is also included in the installation.

Starting equipment for the diesel engine is a standard 32 v direct electric automatic start-stop system. Batteries are maintained by a trickle charger.

Cooling equipment for the diesel consists of a heat exchanger and a water-cooled oil cooler using plant utility water under plant pressure. Raw water flow is controlled by a normally closed electric motor-operated valve which opens when energized by generator voltage.

The 315-kw set provides sufficient power to allow a slow shut-down of fires in the boilers or to operate one boiler at full load in cold weather, preventing freezing of fire protection sprinklers and the steam lines used for heating buildings and process area equipment.

In order to supply emergency power to the heating plant, the nearby gas vaporizer building, and to the two 20 hp pumps which maintain water level in the elevated storage tank, the fireman must make two manual circuit breaker changes on the switchgear (see Fig. 1). A bank of storage batteries which are normally used to operate the switchgear on the air compressors located in the heating plant supplies power to a few emergency lights until the circuit change is made.

The 75-hp fire pump does not need a manual changeover to emergency power, since the transfer switch is set to automatically connect it.

Power for emergency night lights, heat treating furnaces, and the fire protection system in the paint mix room is provided by a 165 kw, 480 v, 60 cycle, 1200 rpm 3-phase diesel-electric generator. This electric set is located in the heat treat area of the main manufacturing building. Switchgear, starting, and cooling equipment are similar to that used with the 315-kw set located in the heating plant.

Diesel-electric set is designed to automatically start and restore power to the emergency system within six seconds when the system voltage is reduced to 70 per cent and to shut down when the voltage rises to 90 per cent of rated. In order to prevent oscillation of the electric set, a transfer switch with an adjustable time delay relay is set to transfer the load back to utility power only after service has continued without interruption for at least six minutes.

Night lighting circuits, operating room emergency lights and the CO_2 system in the paint mix room are connected to both the normal system circuit and to the emergency system through transfer switches at the substations which normally serve them. Should an interruption of power in any substation occur, power will be automatically restored to the emergency circuits served by that substation by power from substation No. 7 (see Fig. 2), which is located near the standby electric set, through a 1600-amp bus duct.

If there is a power failure at substation No. 7, the 165-kw set will automatically start restoring power to those emergency systems requiring it.

Since installation, the entire cost of the emergency system has been saved through protection of production equipment and plant facilities during power outages due to storm damage and through lowered insurance premiums resulting from the presence of adequate standby power in the plant.

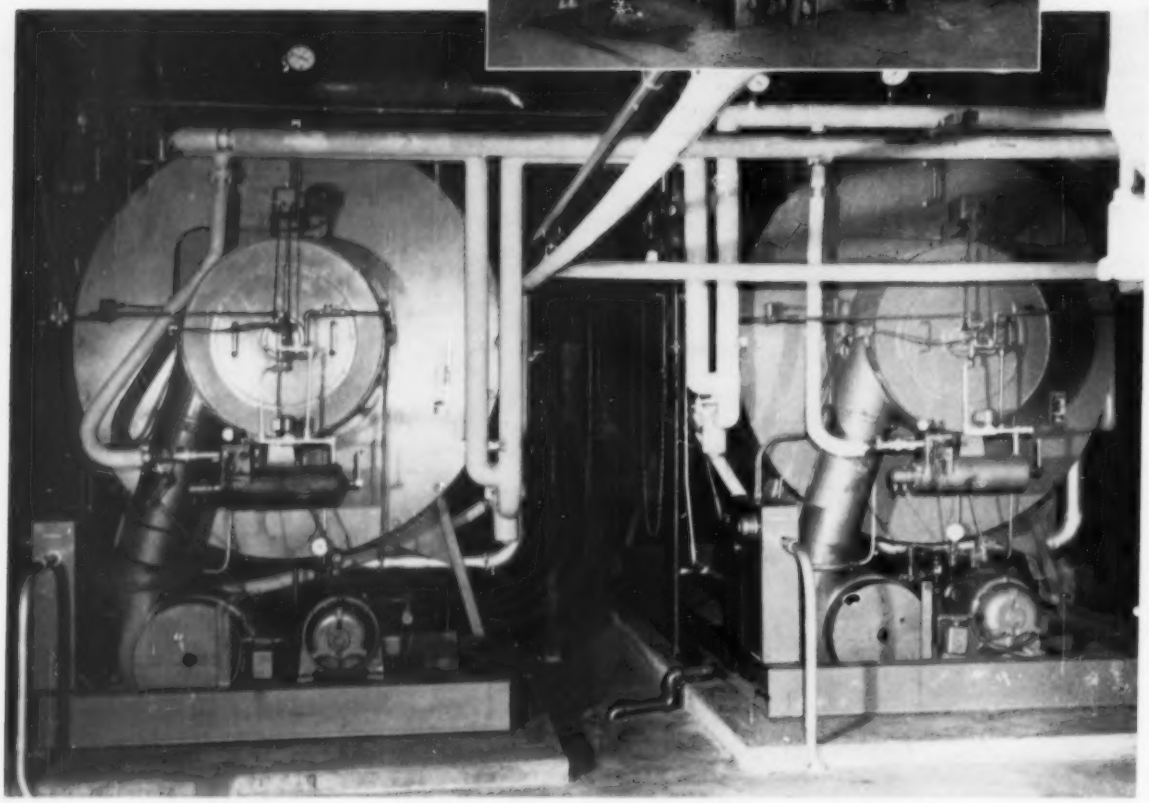


Fig. 1. Above. Old 250 hp McEwen boiler. Fig. 2. Right. Old 325 hp B & W boiler. Fig. 3. Below. Two new 300 hp York-Shipley packaged boilers that have replaced old ones in Figs. 1 and 2

Arcade Modernizes District Heating

By LUKE F. SHARON *

WITH DEFICITS in the municipal central steam heating system of $11,444, $7618 and $9183 for the 3 preceding years, and with the prospects of a similar deficit in 1956, the Village of Arcade, N. Y. was faced with a dilemma.

The 40 consumers of Village steam, one of which was an 1800 pupil public school, generally had no space for individual heating plants on their premises. In the case of the school, land would have to be acquired and a heating plant constructed at an estimated cost of $250,000. The other customers had like problems and the fire hazard from individual heating plants, which had previously been non-existent in the congested business section, was a matter of concern.

The law of diminishing returns would be set in motion by an increase in the steam rate from the present $1.50 per M lb rate; it was obvious that the final outcome of such a rate increase would leave the Village with only one steam heating customer — the public school. Already burdened with a large building debt, the school district would be in no position to make the outlay required for its own heating plant; and neither could it afford to assume the operating expenses of the obsolete and inefficient Village steam plant.

Historically, the village of Arcade

* Superintendent of Public Works, Village of Arcade

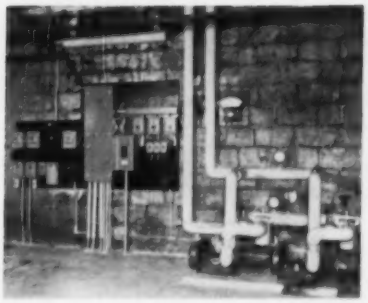


Fig. 4. New control panel on left, tank fuel gage (Levelometer) at right center

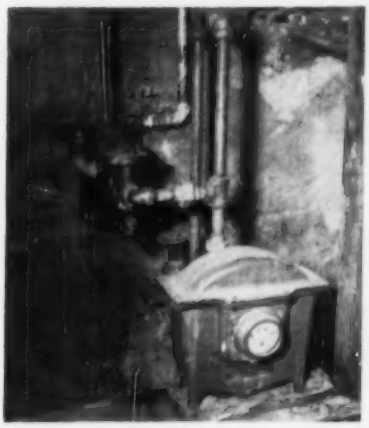
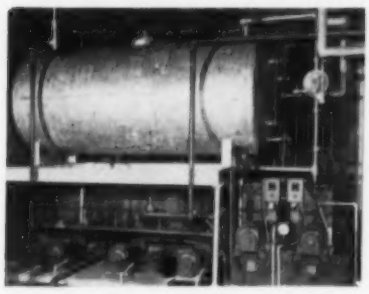


Fig. 5. A typical condensation meter installation on consumer's premises

Fig. 6. Condensate tank, with boiler feed pumps and vacuum pumps below



had commenced central steam heating service back in 1920 when the idea of using exhaust steam from its steam-electric generating plant was conceived. A system of steam mains and condensate return lines was installed throughout the business section of the community at a cost of $25,000 and steam condensation meters were installed on each customer's premises to measure the consumption in lb of condensation. Steam was sold for many years at the rate of 60 cents per M lb of condensation with a fair rate of return on the investment.

Boiler plant equipment consisted of a 325 hp Babcock & Wilcox firetube boiler equipped with a Westinghouse, steam driven, 3-retort underfeed stoker, and a hand fired water tube McEwen boiler of 250 hp capacity. A steam-driven Burnham vacuum pump was used to return condensation from the customers premises to the power plant and a steam-driven Burnham boiler feed pump was used for boiler feedwater supply. The plant had no steam flow metering equipment, coal weighing devices or other instrumentation of any kind.

Economies that might have been realized by converting the 2 units from high pressure to the utilization pressure of 8 to 10 lb were impractical, due to the high pressure steam requirements of the stoker, boiler feed, and vacuum pumps.

Coal was fed to the boilers by means of a monorail system, hoist lift coal bucket and hand shovel-wheelbarrow system. Ash removal was by hand. Coal was delivered to the storage bin from an adjacent railroad sidetrack by means of a dilapidated conveyor belt system. Much labor was involved in unloading coal from the cars; loading the coal in the hoist bucket in the bin; delivering it to the boiler, and removing the ashes.

Faced with the need for a decision to either abandon the enterprise or put it on a paying basis, the Village engaged the services of the firm of Kenneth K. Koontz, Buffalo Heating Engineering Consultants, to make an engineering study and report. The engineer's report, submitted in July 1955, indicated clearly that the system could be made to operate profitably.

There were several obstacles however. Most important of these, it was revealed that after having been in operation for 35 years, the Village had no statutory authority to be engaged in the supplying of central steam heat. Furthermore, the necessary improvements to put the utility on a paying basis were estimated at $50,000 and bonds to finance the improvements could not be sold until the operation was legalized by the State Legislature.

The steam consumers were called together and the entire situation was reviewed for them by the Village, objectively and impartially. It was stressed by the Village authorities that a solution to the problem was sought and that the decision for a course of action would rest with the consumers. It was further explained that if the group decided in favor of retaining and improving the plant, the users would have to assume responsibility for success of the venture and in order to prevent the loss of consumers with the resultant loss of revenue, each user would have to agree to take service for a minimum term of 5 years.

The steam consumers, with 2 or 3 exceptions, were enthusiastic over the prospects of retaining central steam heating and, by their action at the meeting, authorized the Village to proceed with the necessary legislation and direct the preparation of the plans and specifications for the steam plant modernization program.

Enabling legislation was introduced in the 1956 session of the State Legislature, amending Section 89 of the Village Law of the State of New York. This Legislation was passed and enacted into law by the signature of Governor Harriman late in January. The legislation specifically provided that in any year in which revenues were insufficient to pay all costs of service, the deficiency would have to be made up in the next following fiscal year by an increase in rates or through a surcharge prorated among the users.

Plans for the plant modernization were prepared and in April a contract was awarded the R. J. Moran & Sons Co., Buffalo, N. Y., to remove all existing boiler plant piping and equipment and to install new equipment, all for the sum of $49,820. The existing brick stack, 101 ft in height, which had been damaged by a lightning stroke in the upper 50-ft section, was judged to be higher than necessary for the new boilers and repairs which were estimated at $1500 were eliminated by the awarding of a contract to the International Chimney Corporation for $890 covering cutting down the stack to 50 ft, installing a new head, and transferring the lightning rod system.

In September 1956 the removal of the old boiler plant equipment had been completed and two new York-Shipley, 300 hp package unit steam generators had been installed and placed in operation.

The new units, designed to develop full boiler hp at 15 lb working pressure, are arranged for automatic firing with #6 fuel oil. Fully automatic electronic safety controls are provided, including photo-cell main flame control synchronized with programming control panel; burner and flame failure controller, high and low water cut-off with alarm, and high pressure safety cut-off, all of which are connected to a plant alarm system which is also wired into the operator's home over a leased telephone circuit.

The burners are of the pressure atomizing type with full automatic ignition and on-off operating characteristics. Ignition is accomplished by gas-electric means, natural gas being supplied to the burner through a 1½-in. connection from the street.

A 1000 gal condensate receiver was installed for condensate storage and equipped with a McDonnell-Miller water feeder for make-up water requirements.

A Skidmore duplex vacuum pump and receiver having a capacity of 30 gpm and capable of discharging condensate into the condensate receiver tank at 20 lb discharge pressure, was installed and connected into the existing return lines from the customer's premises through a special lift fitting.

A horizontal centrifugal bronze-fitted single stage pump rated 60

gpm at 30 lb pressure with water at 160 F discharges feedwater from the condensate receiver tank to each boiler and a third spare pump is arranged to handle the load of either of the other two in the event of trouble.

Water treatment equipment consists of a heavy duty Permutit semi-automatic type water softener with a capacity of 200,000 grains and service flow of 35 gpm. Push button control is used for the regeneration cycle.

Oil storage is provided by a 15,000 gal horizontal underground tank installed just outside the building and oil is supplied to the burners by duplex type oil pumps, each rated at 300 gph. A Liquidometer Corporation Levelometer installed on the wall near the fuel oil pumps conveniently indicates oil level in the fuel tank.

Fuel oil heating is accomplished by means of 5 electric tail piece heaters with full automatic temperature regulating controls. Fuel oil line heating system between tank and burners has below-waterline exchange heater and electric line heater with temperature control for constant oil heating. The equipment is of Fluid Systems manufacture.

A safety-type steam heater is provided in the fuel oil line with a capacity of heating 330 gph of #6 fuel oil to 150 F temperature rise. Steam to oil exchange heater is Manning & Lewis Admiralty tube type oil heater and will heat 300 gph of #6 fuel oil with 150 F rise with boiler water at 200 F. The heater and regulator are designed to operate at 15 psi.

Two Bailey steam flow meters are provided, each having a capacity of 5000 lb/hr at 8 psig dry saturated steam, one being installed on the steam main supplying the school and one on the uptown steam line. The meters are of the orifice type with integrators to provide a check on the steam sales as registered by individual condensation meters on the customer's premises.

Boiler breeching and all steam piping is covered with a minimum of 1 in. 85 per cent magnesia insulation with 6 oz canvas jacket. Oil and water lines are covered with Johns-Manville Type C Fibrocell with outer canvas jacket. All lines are painted in distinctive and attractive colors.

Operating experience to date has shown substantial operating economies. Delivered fuel oil costs are $.08726 per gal as compared to $8.49 per ton for coal delivered to our railroad siding. Operation of the plant which formerly required 3 full-time and one relief man is now accomplished by one part-time man who spends less than 2 hours per day attending the plant. The services of 2 men from another department of the Village, formerly occupied for 10 to 12 hr per week in unloading coal, are no longer required.

The installation of steam flow meters has provided a check on steam production and sales heretofore unavailable and quickly reveals the loss of steam through leakage, unauthorized diversion or improperly registering meters on the customer's premises. The 1000 gal condensate storage receiver has eliminated the wasting of condensate and the use of electrically-driven condensate return and boiler feed pumps in place of the steam-operated pumps has reduced maintenance costs as well as steam losses.

The new plant is clean and attractive and the almost invisible haze rising from the stack is in marked contrast to the clouds of black smoke which formerly contaminated the atmosphere in the area. The Village authorities look confidently to an end of the deficits in the operation of the utility and the customers are pleased that continuation of the service was made possible by modern, automatic equipment.

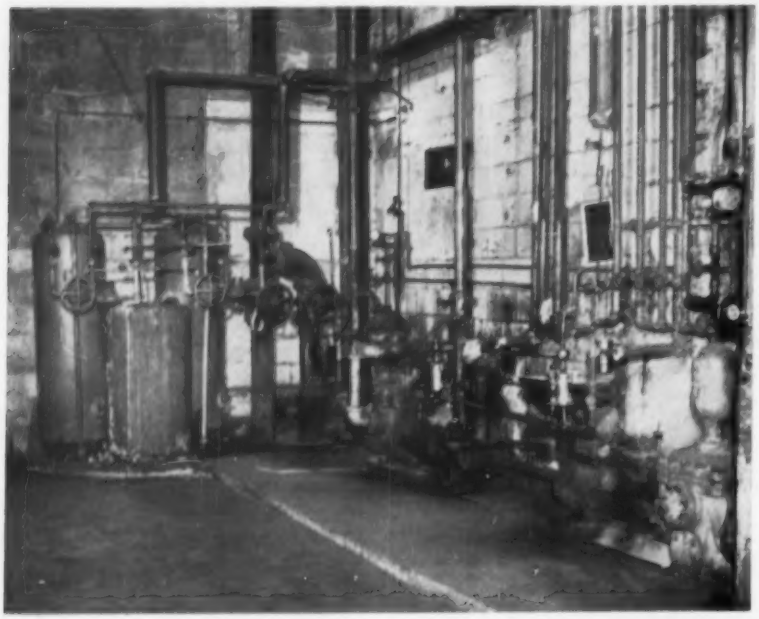


Fig. 7. Corner of boiler house before changes were made. Left to right. Old water softener, steam operated vacuum pump and steam operated boiler feed pump

Fig. 8. New water softener and steam piping arrangement. School steam line on right, uptown steam on left. This is same corner of the boiler house as shown in Fig. 7

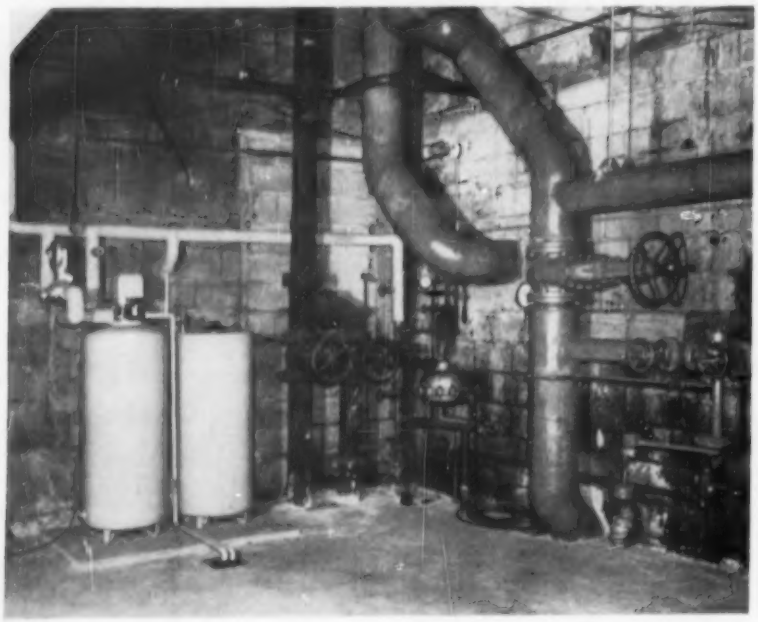


Fig. 1. Badly spalled and cracked walls of building owned by International Salt Co., Detroit, gets repair with new epoxy-based material. Photo shows condition of concrete

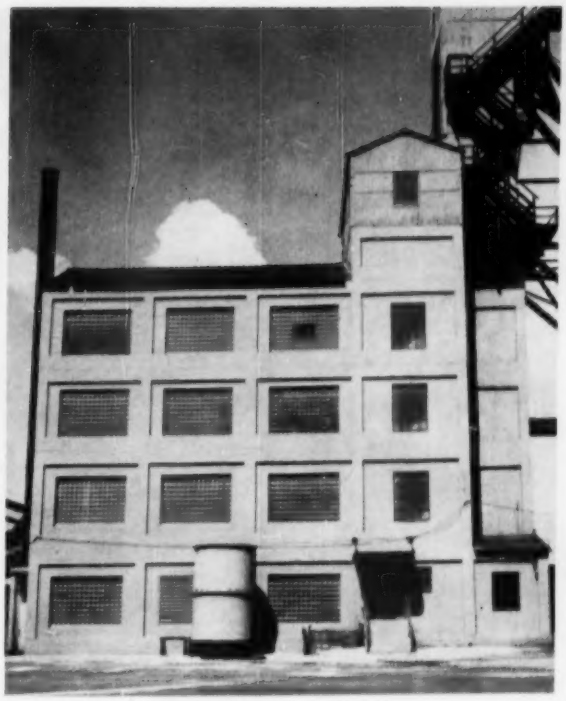


Fig. 2. Photo at right shows same building after repairs with Permagile, an epoxy-based polyplastic alloy. Since material is waterproof, coldproof, repair is permanent

Worried About Concrete Repairs? . . . . This Epoxy Will Fix It

CHALK UP ANOTHER score for that versatile family of plastics known as the epoxies. Already used in an amazing variety of applications, still another product has been developed from this basic material. This time it's a compound said to be capable of welding concrete, brick, cement and cinder block, tile, and other masonry building products with a bond that is stronger than the joined material itself.

Called Permagile, the manufacturers claim the material is exceedingly strong, permanently waterproof, nonshrinking and non-expanding. It is extremely hard and tough, unaffected by aging or atmospheric conditions and is not harmed by alkalis or most acids or chemicals. It withstands temperatures between − 20 F and 270 F, including repeated freezings and thawings. Although a rigid material, it has an elasticity 30 to 40 times that of normal concrete.

Fig. 3. Leaking eroded basement wall is plugged and patched with waterproof epoxy. Bond is stronger than masonry

Permagile is an epoxy-based industrial polyplastic alloy with an average compression strength of 33,000 psi, tensile strength of between 8000 and 10,000 psi, and resistance to water pressure up to 30 psi. Its most extensive use at present is in the restoration of concrete buildings, grain elevators, and tanks. It is also used to repair major cracks and gaps in concrete sewers, floors, basements, and both interior and exterior walls.

Special formulations are available for each of the product's three main functions — joining, filling, and cladding. An example of its cladding possibilities is illustrated in Figs. 1 and 2, which show the restoration of a badly spalled concrete building.

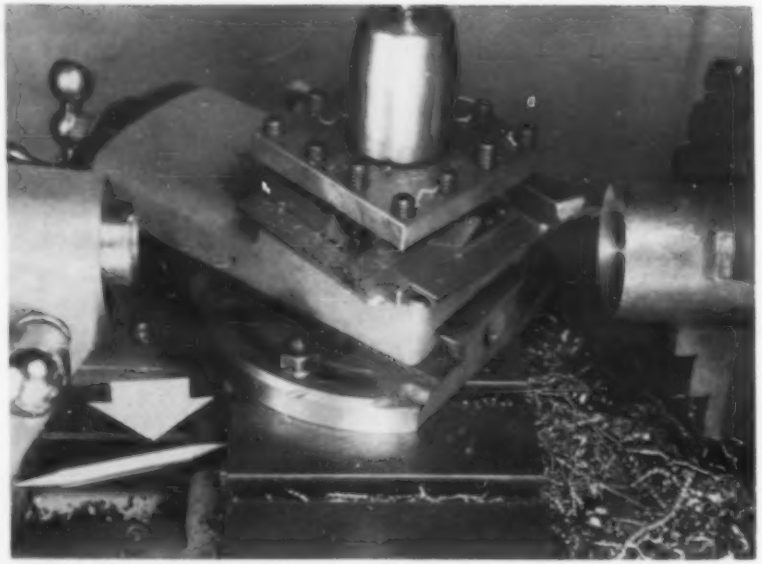
Permagile is supplied in cans as a paste; a separate liquid reactor is added immediately before using. Once mixed, the material must be used within 15 to 30 minutes — however, this pot-life can be extended one to two hours by spreading the mixture on a flat surface to increase surface area.

In order to achieve a good bond and proper curing, Permagile must be applied to a clean, dry surface free of paint, grease, loose particles, and efflorescence. Dampness or continuous water penetration will interfere with hardening. With the standard catalyst, Permagile will harden at temperatures down to 55 F; for temperatures between 55 F and 35 F, a special catalyst is supplied.

Hardening takes place in 8 to 12 hr, but can be accelerated by application of heat from space heaters, infrared lamps, or flame from a propane torch used judiciously.

Subsequent decoration of hardened Permagile can be done with rubber-based paints, which have good adhesive qualities. Other types of paint do not adhere well to the smooth surface of hardened Permagile.

Some well-known users of the new material include New York City Board of Water Supply, New York Telephone Co., and Lever House, N. Y. Readers who wish to have additional technical information concerning Permagile may obtain this information by writing the Editor, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Ill.



Pin with pointed ends is exact length of radius to be cut in chucked stock. Center lines must be aligned

How To Turn a Radius on the Lathe

By F. E. RILEY

LATHE SET-UP illustrated is suitable for the turning of spherical seats in self-aligning washers and the like. It can also be used in another way for the turning of the mating convex part. A perfect sphere cannot be produced with the arrangement, its use being confined to arcs of a limited length.

Photograph is taken from the rear of the lathe and shows a pin with a point at both ends; the pin is held between the cross slide casting and the tailstock body casting. Pointed ends of the pin engage with center-punch marks in the two castings.

Length of the pin is exactly the same as the length of the desired radius. To obtain precision from use of the method, it is necessary that the point of the turning tool be exactly in line with the center line of the lathe spindle and the work. This rule must, of course, be adhered to for similar operations such as taper turning.

Another condition is that the two center punch marks supporting the pin ends should be on a line which is parallel to the top surface of the lathe bed. Once the center punch marks have been placed in position, they can be used for supporting a pin of any length and, consequently, for any radius which it is desired to generate.

One other important requirement when setting up the job is to ensure that when the tool point is on the lathe spindle axis, the pin center line must also be parallel, in both planes, with the spindle axis.

Having set up the job, the radius is generated by holding the pin in contact with the two center punch marks by exerting light end pressure. This is accomplished by holding the longitudinal traverse hand wheel of the lathe saddle in such a manner that the pin is not allowed to drop out of engagement with the center punch marks. The cut is taken across the end face of the work by traversing with the cross slide feed.

Depth of cut can be applied by shifting the tailstock along the bed through a small amount each time a fresh cut is to be taken. On large lathes cutting long length radii, the compound slide can be swivelled at a right angle to the cross slide and increments of cut applied with it.

For turning a convex radius, the pin is sandwiched between a center punch mark made on the other side of the cross slide casting and another made on a piece of scrap steel clamped to the lathe bed. With this arrangement, the pin will be at the other side of the cross slide and under the chuck, in most cases.

fold along this line—outside edges toward you

Simple Work Locating Fixture

By JOHN J. O'BRIEN

WORK too large to be gripped in a lathe chuck must be turned on a face plate; frequently it is also necessary that both ends be machined to run concentrically with one another. Typical examples are yokes on valves, which usually have a circular machined register at one end, and an accurately bored hole with one or two faces at the other.

One procedure when working on valve yokes is to turn the register face first and then locate this accurately on the lathe face plate by clamping a large steel disk in place and turning a locating recess in the disk. The yoke register face engages with the recess in the steel plate and thus is precisely located; clamps hold it against the plate.

This method is conducive to precise work, but is expensive in steel plate. Different sizes of plates accumulate around the lathe and, apart from storage difficulty, they represent an appreciable investment in steel plate which cannot be used for other work.

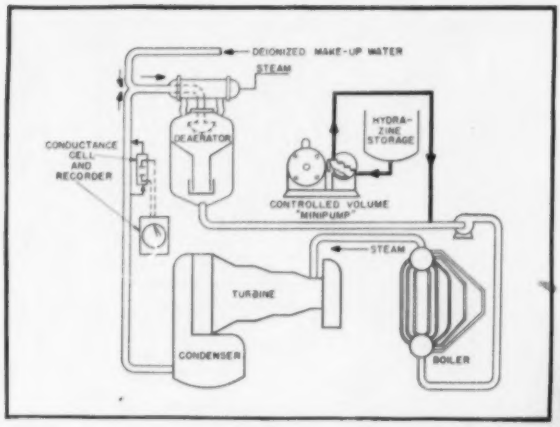
Expensive steel register plates can be avoided by a very cheap method shown in the illustration. Four bolts, with heads outward, are mounted in the face plate slots. The four bolts form four points on a circle and can be turned in the manner shown, same as used for turning a register on a steel plate.

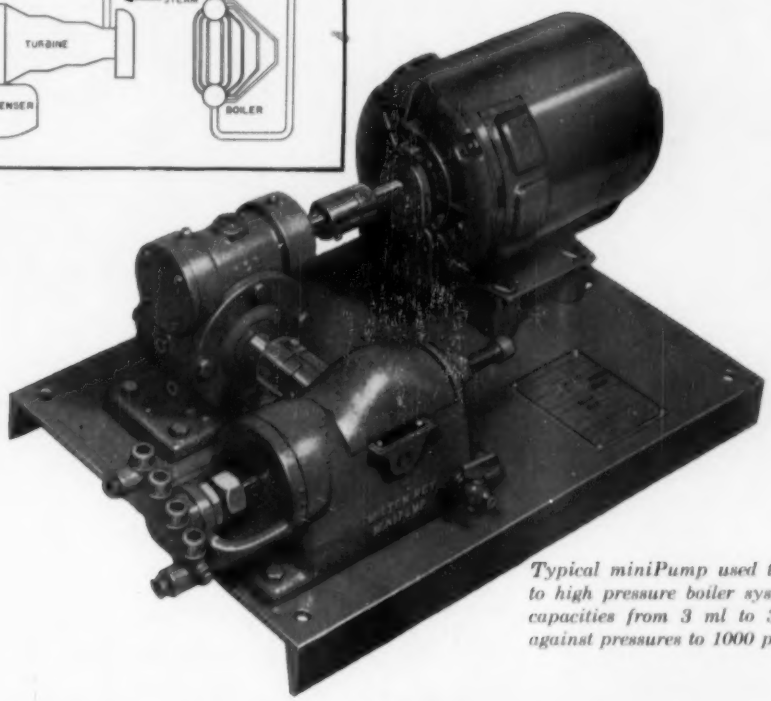
Bolt heads shown have been turned to form a male register for engagement with recess in work and the diameter across each pair of opposed bolt heads represents the size diameter of the register required. It will be noted that the step machined on the bolt heads forms both a locating face and a locating diameter. Clamps can be applied to the work by utilizing the rest of the bolt slot length in the face plate.

A light truing cut can be made to suit each job as it occurs and the bolts need not be replaced with new ones until the heads have been so machined that they are too weak for further use. Bolts should be set on the face plate so that the minimum amount of metal is removed during turning to desired final size.

Four bolts in lathe face plate make a good locator for turning both work ends

cut along this line





Typical miniPump used to meter Hydrazine to high pressure boiler systems. Available for capacities from 3 ml to 3200 ml per hour, against pressures to 1000 psi.

Controlled Volume miniPump® accurately meters Hydrazine to treat boiler feed water

Residual oxygen in boiler feed water causes pitting and corrosion of pumps, economizers and steam lines. Add Hydrazine to the water, and this corrosive oxygen is removed. But it's not quite that simple. Too much Hydrazine liberates ammonia which will corrode admiralty metal tubes in condensers and heat exchangers. Effective feeding of Hydrazine in small quantities (.005-.030 ppm) calls for the accuracy of a Controlled Volume miniPump.

The pump, as illustrated in the flow diagram, meters from 0-225 milliliters of 3% Hydrazine solution in this 500,000-pounds-per-hour steam generating system. The pump controls the feeding of the additive from startup through running conditions. Capacity is adjustable from 0 to 100% of maximum by adjustment of plunger stroke length.

This is but one example of how Controlled Volume Pumps are rewardingly applied to water treating and other chemical metering jobs. Whatever your own requirements, check first with Milton Roy.

Milton Roy Company, *Manufacturing Engineers*, 1300 E. Mermaid Lane, Phila. 18, Pa.

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CONTROLLED VOLUME PUMPS

Engineering representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

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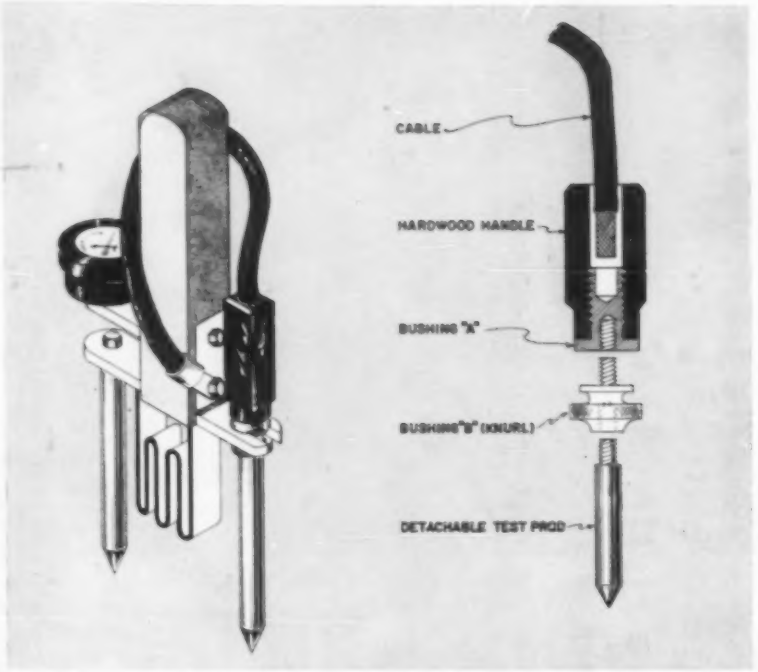


Drawing shows how to modify a conventional battery cell tester to increase its range of usefulness

Extend Use of Battery Cell Tester

By C. H. WILLEY

ADAPTABILITY of the conventional battery cell tester can be greatly extended by the few simple modifications pictured in the accompanying illustration. Spacing of the prods on a standard tester is such that the larger batteries cannot be checked conveniently, but by providing your tester with one detachable prod, any size battery cell can be handled, and at the same time, its convenience for testing standard cells is retained.

To make the modification, obtain a piece of insulated, flexible No. 3 copper cable about 12 to 18 in. long. (Starter cable for 6-volt automotive use is fine.) Remove one prod and slot the bracket to which it was fastened; make two bushings A and B, as shown in the drawing, and a hardwood handle to screw onto bushing A.

Bolt cable lug to slotted bracket and tin the opposite end. Slip handle over cable, then solder cable into socket of bushing A and screw hardwood handle into place.

Shorten pointed end of detached prod to compensate for increased length due to bushing B, then assemble as shown. If desired, sweat prod screw stud into bushing B to prevent any tendency of the prod to loosen.

POWER ENGINEERING HANDBOOK

fold along this line—outside edges toward you

Safe Acid Handling System

METHOD of acid handling, which is of importance to plants using acid in carboys and drums, is described below and shown in the diagram.

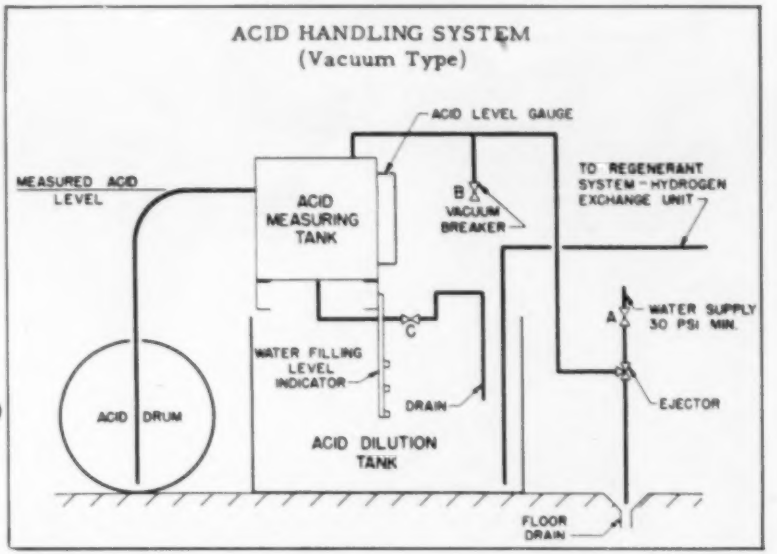
This equipment can be furnished as part of the regenerant system of water treatment processes such as demineralization, hydrogen zeolite ion exchange and acid stabilization. It is designed to provide a safe and simple method of handling any amount of acid that must be diluted with water.

Known as the vacuum acid handling system, it is built to permit the transfer, measurement and dilution of acid to be accomplished without the necessity of lifting carboys or drums and without subjecting any vessels to positive pressures.

Only a water line need be added to the system as furnished. The acid is drawn from the drum or carboy to the measuring tank by the vacuum created by the water operated ejector. When the proper amount of acid is in the tank, the flow is stopped by merely opening a vacuum breaker. Excess acid draws back to supply source. After the dilution tank is filled with water, the measured acid is drained into the dilution tank. The proper amount and concentration of acid is then ready for use in the regeneration system.

Designed to be a simple, safe method of acid handling, measuring and dilution, this vacuum acid handling system, it is stated, has contributed to the increased emphasis on plant safety.

For further information, write the Editor or jot ACID HANDLING on the return post card elsewhere in this issue.



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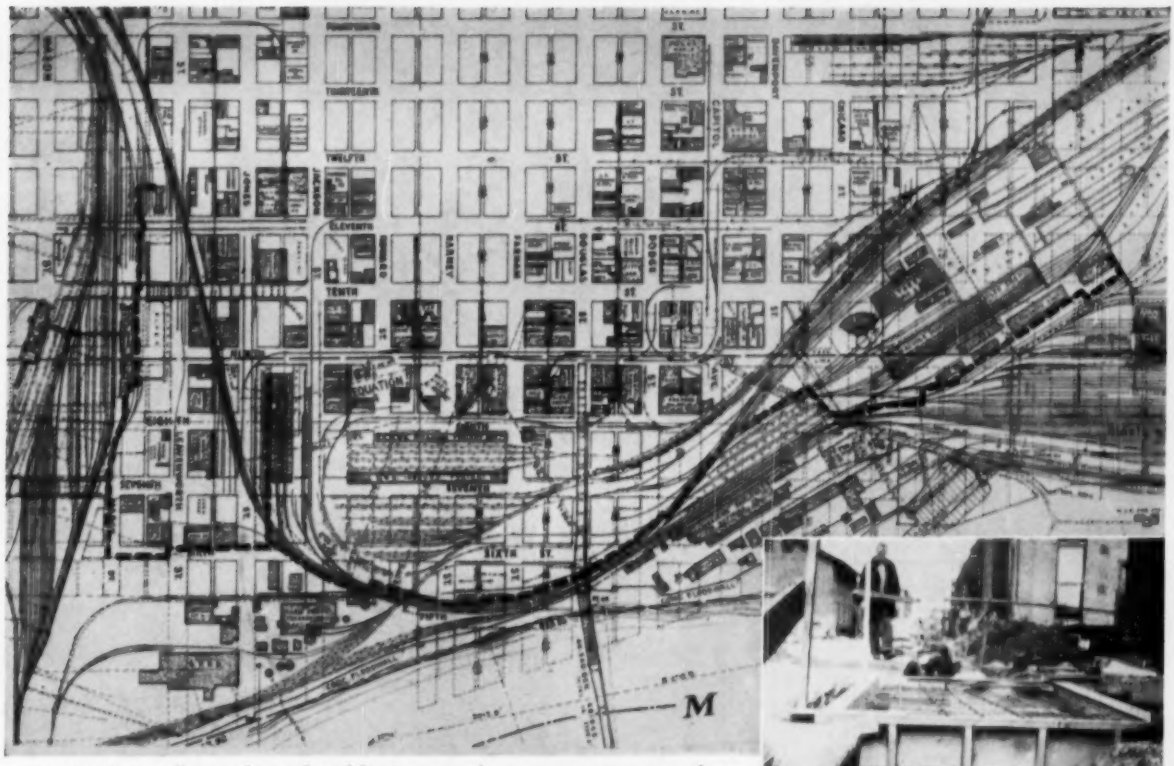

Union Pacific installation (heavy dotted line) runs under pavement to various shops and buildings. Gilsulate has high load-bearing capacity, takes heavy pounding here.

9250 ft. of GILSULATE®-covered steam lines help Union Pacific run smoothly in Omaha

Under tracks, alongside of tracks, under heavily-trafficked streets—practically all types of tough in-service conditions have been overcome by GILSULATE at Union Pacific Railroad's Omaha installation. Running from the main boiler room of the UP shops to the Union Station, the distribution system consists of three sections: 1) a 2800-foot section of 8-inch steam line; 2) 5300 feet of 8-inch steam and a 4-inch diesel oil line; 3) 1150 feet of 3-inch steam line branching from section (2) and carrying 150 psi steam plus 100 degrees superheat.

First installed in 1954 and continually subjected to pounding, shock and vibration from heavily-loaded freight trains and normal yard traffic, this GILSULATE system has functioned flawlessly. 810 tons of Type C GILSULATE were used initially, and additional installations are being made here and at other Union Pacific yards.

GILSULATE's insulating efficiency, all-around pipe protection, and high loading capacity make it the ideal choice for this and other types of installations. More and more, architects, engineers and contractors are discovering that GILSULATE provides permanent corrosion protection for hot underground pipes at the lowest cost per installed linear foot of any other pipe insulation system.

Investigate the value of low-cost, easily-installed, dependable GILSULATE. See your local GILSULATE distributor for a convincing demonstration. Complete details are yours for the asking. Write the office nearest you.

AMERICAN GILSONITE COMPANY
SALT LAKE CITY 1, UTAH

Affiliate of Barber Oil Corp. & Standard Oil Co. of Col. OFFICES at: 134-N West Broadway, Salt Lake City, Utah; The Agents Building, 3537 Lee Road, Cleveland 20, O.

An 8-inch steam and 4-inch diesel line entering a bellows-type expansion joint in a manhole; system was installed by UP crews.

FACTS ABOUT GILSULATE

1. **EASY TO USE**—just pour and tamp... pipe heat does the rest.
2. **FORMS 3 ZONES** of protection against heat loss and all hazards commonly encountered by hot buried pipes.
3. **NEEDS NO HOUSING OR MECHANICAL SHEATHS**: no mixing, special handling or equipment.
4. **ONLY NEEDS NORMAL PIPE SPACING**: for multiple pipe or cramped conditions.
5. **THREE TYPES AVAILABLE**:
   Type A for 220°-300°F. temp. range
   Type B for 300°-385°F. temp. range
   Type C for 385°-520°F. temp. range

GILSULATE®
The Triple-Zone Insulation System For Lifetime Protection of Underground Hot Pipes

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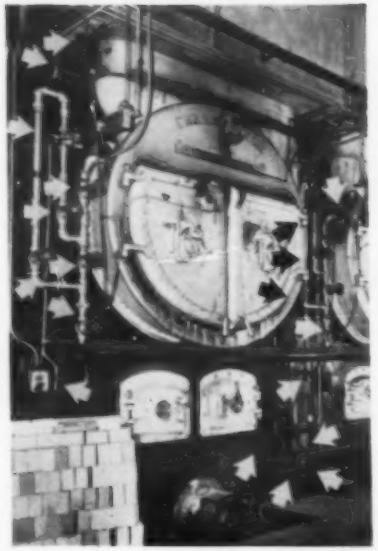
Color Helps Identify Valves in Emergencies

By H. D. FISHER

WHERE A NUMBER of oil-fired horizontal return tube boilers are set in a single battery there is usually quite a congestion of valves on the boiler fronts, as is indicated in the illustration. Even so, a fireman capable of operating the boilers is naturally expected to know which valve is which.

However, any simple, inexpensive system which helps him identify the individual valves readily is a desirable aid; in emergencies, when he must put his hand on the right valves without delay, such a system is downright valuable.

We have adopted, therefore, the scheme of painting all valves with distinctive colors for instant identification: blue for feedwater, red for water column and water glass drains, yellow for low water cutoff drain, green for feedwater regulator casing drain, etc. Any other selection of colors and equipment to be painted may be made to suit the installation and its requirements. Once seen, the effectiveness of this system is immediately apparent.



Arrows (right) show how many valves fireman must be able to identify at a glance in emergencies

New Tools Speed Splicing of Conveyor Belts

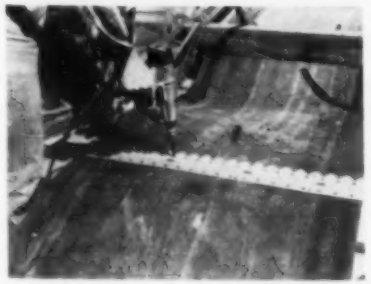


Fig. 1. Standard power tool boring bit is used to bore holes in the belt for the insertion of fasteners

METHOD SHOWN in Figs. 1, 2, and 3 illustrates a new and faster way to splice conveyor belts.

Templets eliminate the inconvenience of inserting fasteners from the pulley side of the belts. A new boring bit and alloy steel wrench have been designed for use in standard electric or air impact tools.

Field tests with these new tools have shown that a two-man team can apply fasteners on a 30 in. wide joint in 15 to 20 minutes.

For more information, write the Editor, POWER ENGINEERING or jot Belt Fastener on the return post card in this issue.

fold along this line—outside edges toward you

Fig. 2. With fasteners inserted through the holes in one end of belt, the templet positions the bolts

Fig. 3. Nuts are being run down with the power tool wrench, while excess of bolts is broken off

Ever Try Flame Rotation on Adjacent Oil Burners?

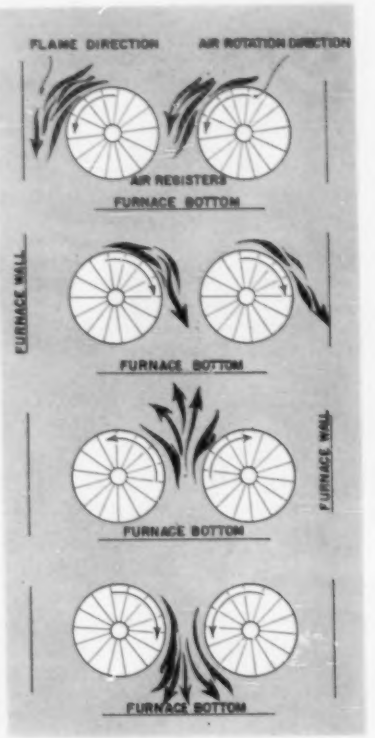
By JOHN M. DRABELLE

THE SCHEMATIC shown here indicates how combustion air can be introduced into adjacent oil burners most effectively. The idea is simple and practical, and comes from an operator in a southern power plant, where it was used with good results, with Bunker C oil.

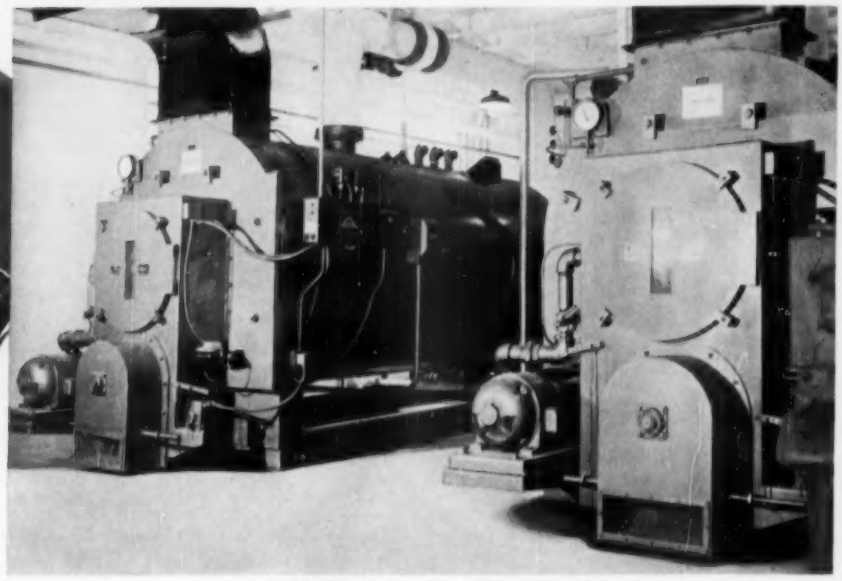
If the combustion air for two adjacent burners rotates in the same direction, the flame will tend to be thrown toward the walls, as shown in the two upper sets of drawings in the sketch. But if the combustion air on the left-hand burner rotates clockwise, and that on the right-hand burner rotates counterclockwise, the flame trend will be downward toward the bottom of the furnace (lower drawings). This should result in the boiler steaming more freely (due to the larger waterwall pickup), superheat settling down, and stack emission reduced materially.

You get the different rotations, of course, by adjusting the register vanes in the burners to suit. This seems to be an old serviceman's trick but I cannot find anything on it in the textbooks.

Servicemen always know small details of operation and performance improvement like this that are never written down anywhere. They can show boiler operators many tricks with the equipment that save much cut-and-try effort and time. It pays to get well acquainted with them.



"No engineer likes a gamble. That's why I want the UNFAILING DEPENDABILITY of Packaged Boilers"



Two 175-HP Gas-Fired Continental Automatic Boilers, installed at Tri-County Joint School District, Canton, Pa.

"As an engineer, I can't afford to take a chance. So when we design a modern heating plant, I make certain we get dependability. In fact, that's why I insist on Packaged Boilers.

"Heating, power and process requirements are always of vital importance. That's why two Packaged Boilers, each designed to carry 75% of the maximum demand, may very well be a better buy than one built-up firebox type of boiler. Sure, that's conservative designing. But it pays off in winter-long reliability, no matter what the weather.

"Later, if new buildings are added or there's some other need for increased steam production, it's easy and economical to install another Packaged Boiler. So we not only get dependability, but flexibility, too. That kind of a package makes everybody happy."

Six Reasons Why it Pays to Buy a CONTINENTAL Automatic Boiler

- Guaranteed 80% efficiency . . . Fire-tested before shipment . . . Range, 20 to 500 hp.
- Simple, practical two-pass design, for uniform flow of combustion gases through all return tubes.
- Maximum radiant heat transfer achieved by "Spinning Gas" technique for thorough mixing of air and atomized fuel.
- High-CO_2 and low-temperature stack gases — proof of high combustion efficiency.
- Free, rapid water circulation improves heat transfer, keeps heating surfaces clean.
- Easy access to furnace and all return tubes. Refractory baffles and brickwork are not required.

For details on the Continental Automatic Boiler, send for Bulletin BE-3

BOILER ENGINEERING & SUPPLY COMPANY, INC.

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A HALF CENTURY OF BOILER MANUFACTURING EXPERIENCE

The Continental AUTOMATIC BOILER

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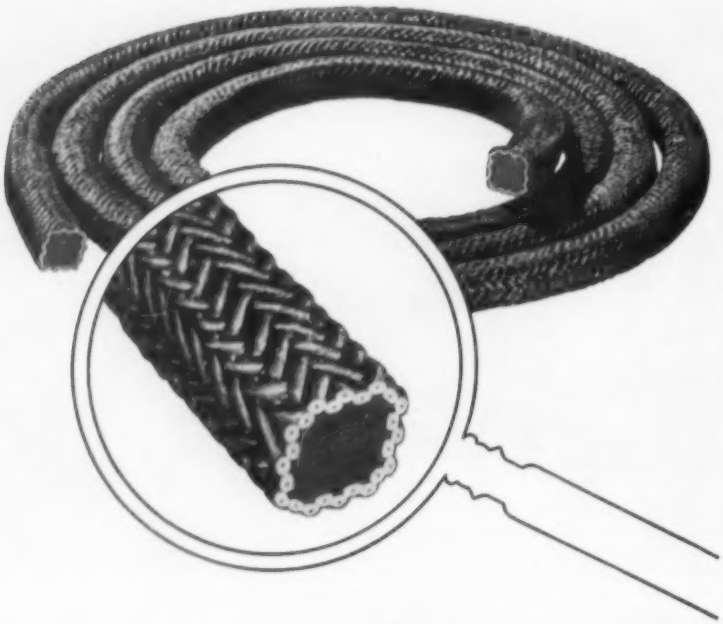
for superheated pressures



BELMONT 4040

Here is a steam valve packing that performs well on superheated steam temperatures as high as 800° F.

Inconel wire-inserted asbestos is braided over a non-metallic plastic core to combine strength for high pressures with compressibility for good sealing characteristics. Supplied square in cross section, in sizes 5/16" and up.

Ask your convenient Belmont Packing Distributor or write for Catalog No. 56.

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Engineering Meetings

continued from page 69

in turn for a 3-min rebuttal to points made from the floor. First half of the session was over by 11:15 and the Chairman announced a 5-min break.

Procedure of the second half of the session was same as the first, with, however, another reporter, Dudley Fuller. This session was not so well attended as the first, due, no doubt, to the attractions of the Atlantic City boardwalk on a beautiful, sunshiny day. Meeting was declared closed about 1:00 P.M.

General impression was that the meeting should have been better than it turned out to be. The program and program officials carried out their part of the session business very well. Organization and timing were excellent, and the Chairman and reporters worked with authority. There was little confusion and fumbling with microphones, due to smooth work by the attendants. Any failure — if such it might be called — lay with the apparent reluctance of the audience to do its part. And in this kind of meeting, the members must do at least half the ball-carrying.

It is difficult to assess the reasons why the audience did not respond more completely. Probably most did not understand the purpose and potential value of this type of meeting — a style which permits utmost participation and personal benefit. One cynic declared that too many in the audience were "deadheads", present only because of the boardwalk, a trip out of town, or to impress the boss. This is an overly-pessimistic view; it is more reasonable to believe that the idea was a new one and the men did not know what was or would be expected of them.

To enhance the value of future meetings of this kind, it would be well for the technical journals to discuss the reporter method of paper presentation and publicize both its advantages and the means by which individuals attending can extract the most from its inherent benefits — and there are many.

We urge ASME and ASLE to continue this style of handling a number of papers; most of those at the Conference liked it, and will like it more as they learn to take a greater part in its proceedings. At least, nobody fell asleep.

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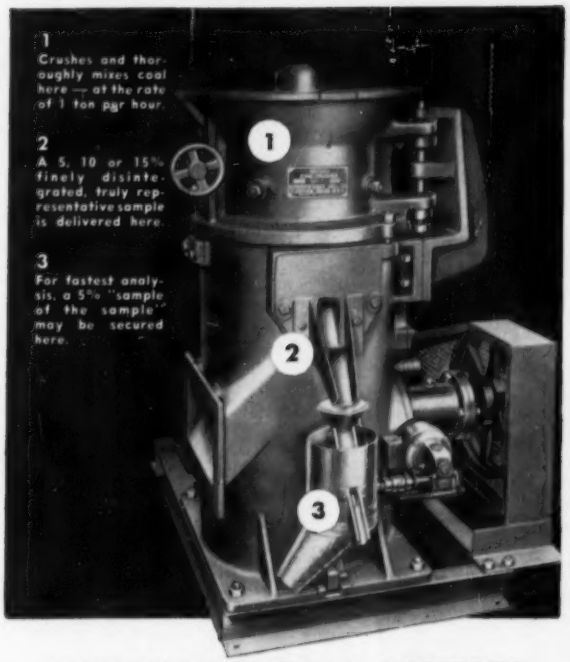
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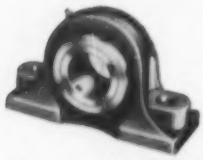

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NEW ENGINEERING BOOKS

Hydraulics Refresher for Professional Engineers License by John D. Constance. Second Edition, 1956. Approximately 75 pages, 8¼ by 11, paper. Published by the author, 625 Hudson Terrace, Cliffside Park, N. J. Price $3.00.

This book has been designed as a home study instrument for candidates intending to take examinations for professional engineer and civil service examinations for engineering grades. It is particularly valuable for candidates who find formal refresher courses inaccessible or inconvenient for some reason.

The text consists of a large number of examples with the solutions worked out in detail. Examples are all taken from previous examinations. When the contents formed the complete bound lectures of a performance-tested refresher course, it was given by the author under the sponsorship of the American Society of Mechanical Engineers in New York City. It has now been re-cast to help candidates in all the states.

Illustrative problems have been carefully selected and screened and the subject matter treated in a concise and practical manner. In all cases the practical aspects of each problem are reviewed and the necessary practical formulas given with solutions worked out mathematically.

In this second edition, the following additions to the problems section have been made: Specific gravity and density relations; Valve testing conversions; Branch piping networks, and nozzle horsepower. In addition, a completely new section on equivalent pipes and loop flow distribution, with selection curves, has been included. This subject fills a much needed gap in examination material. Relative carrying capacities of pipelines of equal smoothness, and how to determine the number of branch types a header can normally accommodate, are useful new additions to the text.

Mathematics Refresher is similar in general presentation to the Hydraulics Refresher just described. In order to obtain a license by written examination, the candidate must show skill in mathematical manipulation as well as skill in actual application of mathematics to the solution of engineering and land surveying problems. Mathematics Refresher provides the candidate with a good insight into ways and means for answering these problems in as convenient a manner as possible. First Edition, 1956. Price $2.00.

The problems are complete with solutions and diagrams and explanations and reflect extensive sampling based on a survey of many states' examinations.

Architectural Refresher, by Constance and F. E. Ferrucci, contains problems appearing in the written examination for Professional Engineer in New York State (Structural Planning & Design, Part I) have a definite reason for being there. A candidate obtaining licensure in New York automatically and legally is permitted to affix his seal to architectural drawings for filing with local and state authorities because of this requirement. In the state of New Jersey a registered professional engineer must pass the architectural design section of that state's architectural examination before he may do the same.

The authors point out that this is the first organized attempt to publish, under one cover, a large selection of past problems with the answers in sketch form. First Edition, 1956. Price $2.50.

* * *

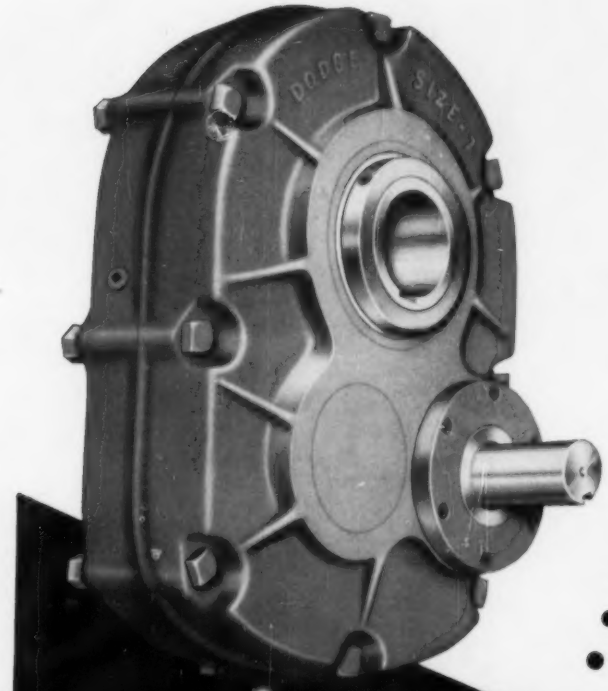
How to Get Industrial and Business Publicity, by Charles E. St. Thomas, size 6 by 9; 166 pages including index. Published by Chilton Company, Chestnut & 56th Sts., Philadelphia 39, Pennsylvania. Price $5.00.

From the editor's standpoint, this book is just what the doctor ordered for those industries and companies which fail to get the proper publicity and publication of their technical press releases. Here is a step by step method by which a firm can make use of effective publicity; the book is not concerned with why a publicity operation is necessary, but with how such a function can be organized and run.

The author, long a public relations expert, has set down the duties and functions of a publicity department from the initial organization, the actual physical set-up of the office itself, to the final contact with the industrial press editor. He covers such aspects of the problem as the publicity man's contact with key company personnel, the advisability of having him participate in company meetings, and his personal contacts with the press itself. All important phases of organizing and operating a publicity department or function are covered simply and with great clarity. Wisely, we think, the book is addressed particularly to those smaller firms to which good publicity can bring direct results, but it is also extremely valuable for all business personnel concerned with public relations.

Taken at random from the table of contents, here are some of the subjects covered: How to Organize for Publicity, Personnel Necessary, Selecting Personnel, Forms and Working Procedures, Basic Activities of the Publicity Man, How to Release Publicity, Preparing the Release, Product Stories, Plant Visits by Editors, Press Conferences, Measuring and Reporting Publicity for Greater Effectiveness, Relationship of Publicity to Advertising and Sales Programs, etc.

This book is heartily recommended to all firms, regardless of size. For those who have no publicity department at all it is a necessity. But it will also serve as an effective check on the current publicity operations of firms who already have an industrial publicity department.



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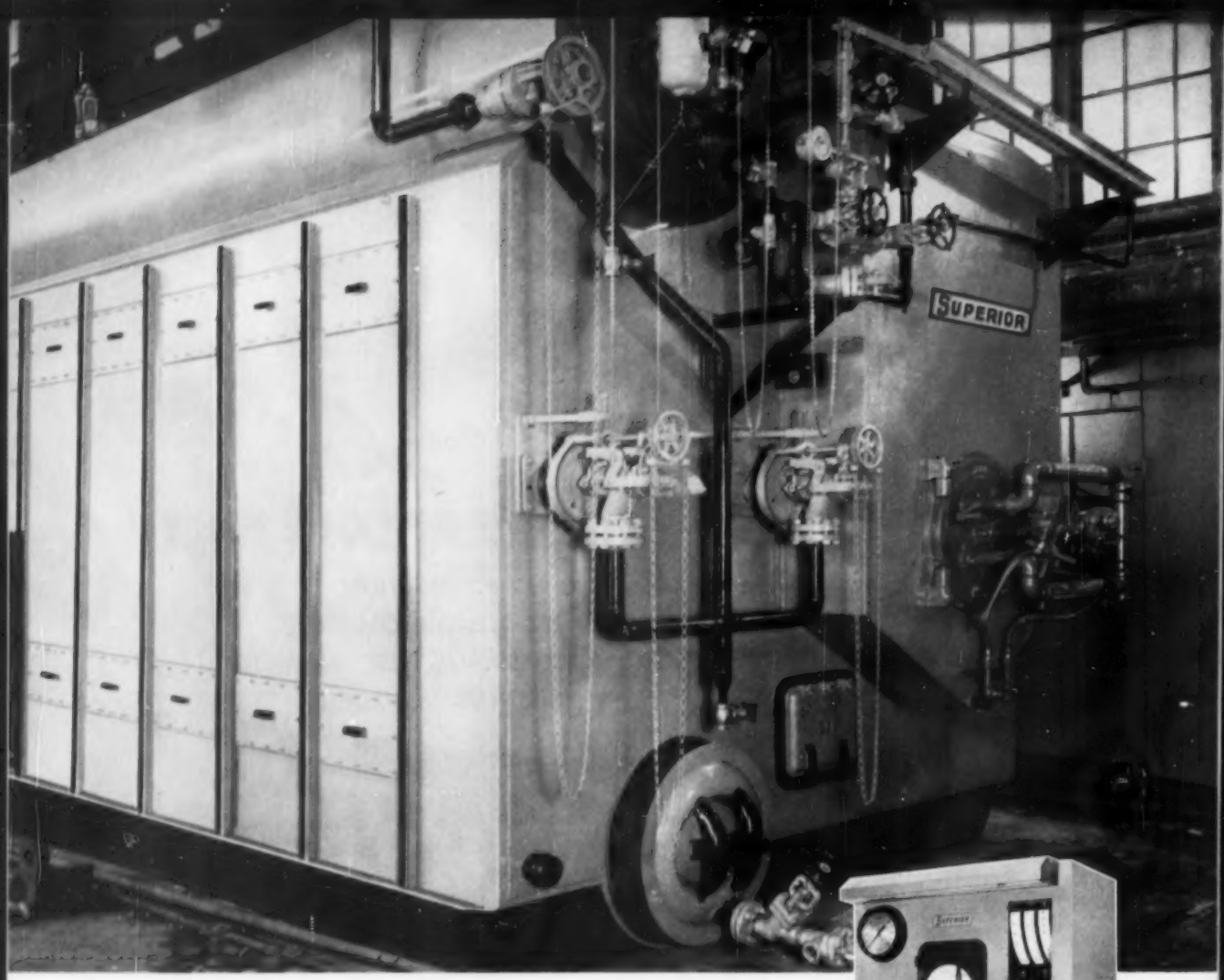

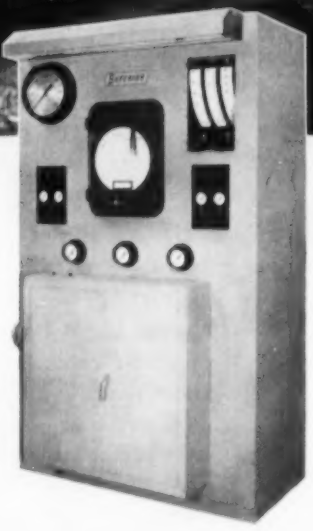

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INSTRUMENTS, CONTROLS

201 **Boiler Feed Control** — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater. Copes-Vulcan Div., Blaw-Knox Co.

202 **Instrument Panels** — Power and process plants can choose instrument and control panels to meet individual specifications from six standard designs described in 16-pp Product Specification G71-7. Complete specifications are furnished, as well as information on supports and mountings for tubes, wires and equipment, instrument mounting dimensions, and dimensions of standard instrument and control panels. Bailey Meter Co.

203 **Easy Reading Gage** — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

204 **Oil Leak Detection** — Eight-pp illustrated Bulletin 80, on the Paraprobe oil leak detection system for steam-type fuel oil heaters gives a detailed explanation of the operation of the system. Provides installation diagrams, standard specifications, explains determination of condensate flow rate. Davis Engineering Corp.

205 **Instruments, Controls** — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

206 **Solenoid Pilots** — Several types of solenoid pilots for use with company's regulating valves are described in Form 1010. Lists reasons for economies in on-off control, describes applications, and gives type of pilot, material of construction, maximum pressure and maximum temperature for two- and three-way pilots in steam, gas and liquid service. Schematic diagrams of typical applications are given. Spence Engineering Co., Inc.

207 **Indicating Flow Meter** — Bulletin 18-A, 22-pp, discusses advantages, construction and operation of company's Type H indicating flow meter. Presents technical data on the principles and theory of fluid measurement and discusses orifice type meters and orifice meter principles. Offers examples of flow rate calculations.

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Schematic drawings and diagrams, tabulated technical data and specifications are included. The Meriam Instrument Co.

208 D-C Amplifier — Twelve-pp Bulletin MSP 111.1 provides pictorial diagrams and descriptive information on company's PowrAmp Model P, an electronic low-voltage linear amplifier designed to increase the speed and accuracy of low level d-c voltage measurements. Discusses performance and construction features of the amplifier and describes some applications. Hagan Corp.

209 Ideas on Push Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

MECHANICAL POWER TRANSMISSION

210 V-S Drive Selection Tips — Bulletin 20P50, 44 pp, carries handy multi-color tables for quick and easy selection of variable speed Texrope drives. In addition to providing these tables for A, B, C and D section variable speed drives, booklet includes information on design features, drive principles, horsepower rating tables, speed range table. Allis-Chalmers Mfg. Co.

211 Fluid Drives — Bulletins 9419 and 9519 are an illustrated catalog and selection guide on company's new Type VS Class 2 Gyrol fluid drives. Catalog discusses advantages and applications of the drives, covering speed control, power savings, simplified installation, etc. A sectional view shows construction and principle of operation. Dimensions for six sizes of drives are provided. Selection guide consists of tables indicating proper drive to use. American Blower Corp.

212 Speed Reducers — Design and operation advantages of company's line of Torque-Arm speed reducers are outlined in 28-pp Bulletin A-637. Includes selection tables for double and single reduction units, bore dimensions and bushings, data on overload releases, flange mounted speed reducers, and recommended V-belt drives. Dodge Mfg. Corp.

PUMPS

214 Controlled Volume Pumps — Bulletin 953, 24-pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

215 Steam Pump Care — Bulletin G-2280, "How to Install and Take Care of Steam Pumps," is a 24-pp booklet containing a step-by-step series of 88 illustrations showing how to increase the service life of all types of steam pumps.

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It offers 28 tips on proper installation of the pumps, 54 tips on care techniques. Section on installation provides information on suction, packing the pump, starting it, and trouble shooting. Section on maintenance deals with such subjects as steam valves, liquid piston and rod, piston packing, liners. Worthington Corp.

216 Meter that Pumps — Bulletin 300, 8 pp, describes company's improved meter that pumps — designed for precise metering and proportioning of small quantities of low viscosity fluids at low cost, over extended periods of time. Complete capacity tables and a detailed schematic are also included. Hills-McCanna Co.

BOILERS, GENERATORS

217 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 40,000 lb per hour. Space requirements are shown in a table with specifications. Combustion Engineering, Inc.

218 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

219 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

220 Boiler Family — Bulletin B-3300-A describes a wide range of company's heating and power boilers and includes photos and cutaway views showing construction features. A list of bulletins on the various types of boilers is included. Titusville Iron Works Div., Struthers Wells Corp.

221 Standard Generators — Bulletin B-55-4 describes company's SC economy series of standard steam generators designed to reduce steam costs for industrial plants. Pre-engineered, standardized steam generators offered in nine sizes, with capacities of from 50,000 to 150,000 lb per hour are described, and schematic and cutaway drawings of the units and design features are included. Foster Wheeler Corp.

222 Water Tube Boilers — This 12-pp catalog describes packaged water tube boilers, in capacities from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

223 Packaged Generators — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

224 Shop Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2000 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

REFRACTORIES, INSULATIONS

226 Insulations, Refractories — This 20-pp catalog features thermal insulations and refractories for general industrial applications. Organized for quick reference, catalog provides information on composition, physical and thermal properties and sizes of the various products. Lists chief advantages, covers materials for efficient control of temperatures from — 400 F to 3000 F. Johns-Manville.

227 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

TUBING AND ACCESSORIES

228 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven

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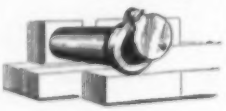
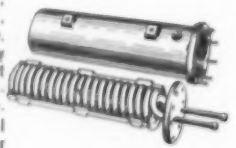


Furnace Relief and Access Door, heavy construction, practically air tight. Door casting correctly weighted, lined with plastic refractory retained by imbedded grill; with observation port and cover.

Fuel Oil Heater, Self-Cleaning, Spiral Coil Type. High oil velocity in coil, resultant turbulence prevents carbon formation. No internal connections or joints.



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rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

229 Life Extension for Condenser Tubes — The 32-pp current edition of this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

230 Tube Tools — Eight-pp Bulletin 58 describes advantages and application of company's line of tube cleaners, tube expanders and maintenance tools, including drills, brushes, accessory and specialty tools. Photos are included as well as size and selection data. Airetool Mfg. Co.

231 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required tubing that would withstand this rigorous wear. The International Nickel Co., Inc.

232 Tube Expanders — Catalog 88, 119-pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is fully described, applications are listed, and tables of engineering data included. Also covers tube expansion methods, tool maintenance, expansion calculations and charts giving pipe and tube sizes. Thomas C. Wilson, Inc.

FUEL BURNING EQUIPMENT

233 Automatic Burner — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

Postage-free cards for ordering catalogs are on page 97. You may also use the cards to order literature mentioned in the ads.

234 Oil and Gas Burners — Bulletin OB-53, 28 pp gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity

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of oil burned, boiler capacity and air required for combustion. The Engineer Co.

235 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

COAL, ASH HANDLING

237 Tractor Shovel — The engineering, design and production stories of company's HD-11G tractor shovel are pictorially presented in 8-pp Catalog MS-460. Includes specifications and describes various features which mean easier servicing for less time-down and greater operator comfort. Allis-Chalmers Mfg. Co.

238 Improved Crushers — Bulletin 12-C, 16-pp, describes company's line of crushers for reducing coal, coke, glass cullet, gypsum, lime, metal turning, sugar, sulphur and similar lump materials. Covers Knittel ring type crushers, two-stage double-roll crushers, single-roll crushers, and double-roll crushers. Photos, dimensional drawings and full specifications are included. Stephens-Adamson Mfg. Co.

239 Coal Crusher — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

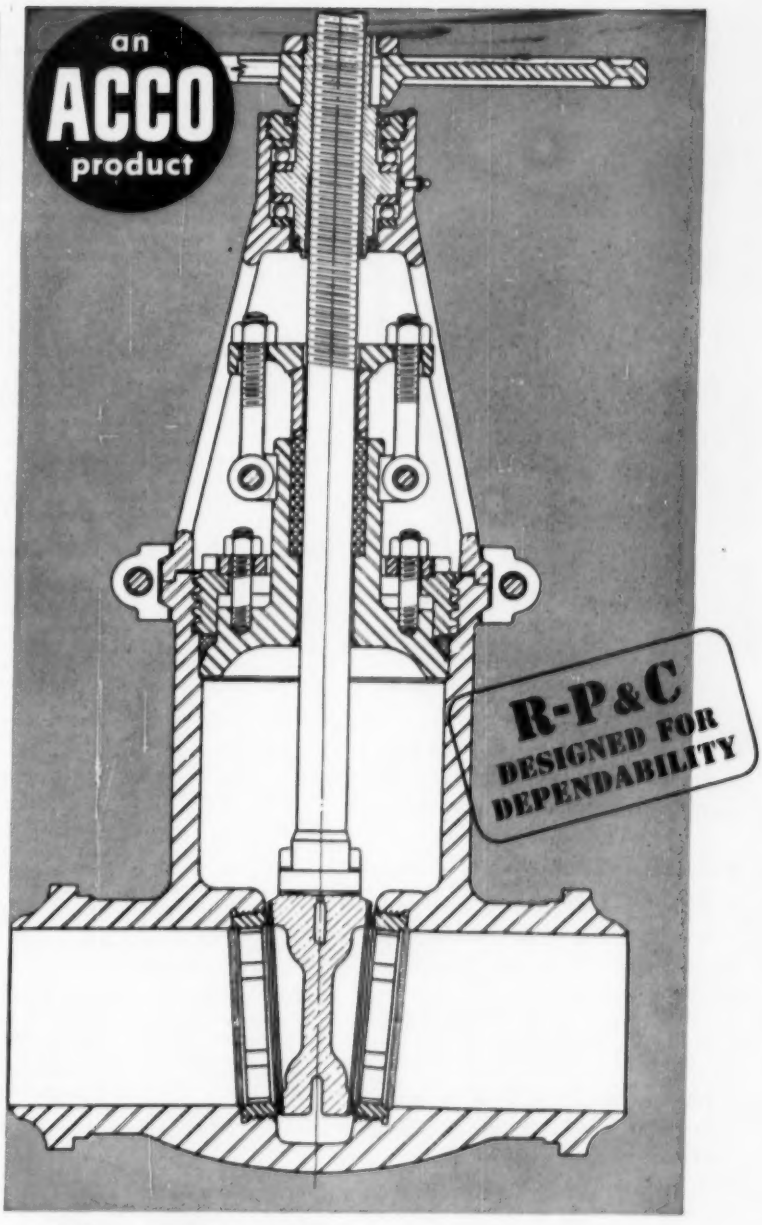
240 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March Corp.

WATER CONDITIONING

241 Water Conditioning Data Book — An excellent reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title when requesting this. The Permutit Co.

242 Handbook on Demineralizing — Comprehensive 40-pp Bulletin 5800-B compares various methods of water treatment, indicating the comparison between demineralizers and evaporators. It discusses the characteristics of the various types of available cation and anion exchange materials and offers data on operating costs of demineralizing. It tells when to use 2-bed, 3-bed, 4-bed, mixed or monobed demineralizers. It also indicates when decarbonators or vacuum deaerators should be installed. Cochrane Corp.

243 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in



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8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

244 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising the pH value of the condensate. The Bird-Archer Co.

245 Steam System Treatment — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

246 pH and Chlorine Control — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrite, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness. Available to qualified power engineers. W. A. Taylor Co.

247 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

248 Carbon Dioxide Measurement — Technical Paper 133, 16-pp, discusses determination of CO_2 in water by conductivity measurements. Describes a new method developed for the determination of carbon dioxide which is applicable to analysis of waterside deposits, treatment chemicals and organic carbon in water. W. H. & L. D. Betz.

LUBRICANTS

250 Lithium Soap Greases — This product information bulletin details qualities and specifications of company's multipurpose lithium soap industrial greases. Advantages of multi-purpose grease use — such as prevention of lubricant misapplication, simplified maintenance procedures are discussed, together with performance characteristics. Sinclair Refining Co.

251 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, uses, properties. Standard Oil Co. (Ind.)

252 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication

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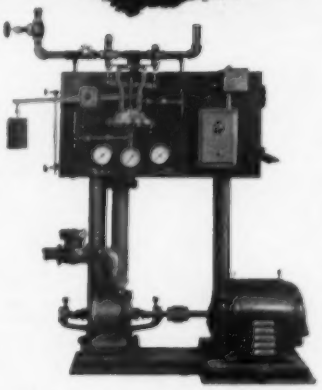

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magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved, in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The Texas Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

253 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

254 Lubricated Plug Valves — Catalog PV-24, 36-pp, shows in detail a line of iron and steel lubricated plug valves. Many illustrations of the single, screwed and bolted gland type valves are shown, including photos, sectional and detailed drawings. Also included is physical data on dimensions. The Wm. Powell Co.

255 General Purpose Valves — Supplement No. 1 to Catalog F-9, 32-pp, offers complete information on company's series of general purpose drop forged steel valves, gate, globe and angle types, sizes ¼ through 2 in. Includes descriptions of each type along with drawings showing component parts. Dimensions and other specifications are tabulated, and a pressure-temperature ratings table is included. Henry Vogt Machine Co.

256 Valve Chart — Form 194, 24 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

257 Boiler Blow Off Valves — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

258 Water Hammer Control — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and test data is presented to show efficiency of company's silent check valves in water hammer control. Some typical installations are illustrated. The Williams Gauge Co., Inc.

259 Valve Charts — Now available to power engineers are three well-organized wall charts on valve types, selection and protection. "How to know valves" covers four main types of valves from the standpoints of their appearance, inside construction, service intended, operation and use. "How to select valves" discusses five major factors involved in the choice of a valve — fluid, temperature, pressure, size and function. "How to protect valves" — written in "do and don't" style covers 11 important points in valve installation, operation and maintenance. R-P & C Valve Div., American Chain & Cable Co., Inc.

260 Pump Valves — Key features of company's line of pump valves are out-

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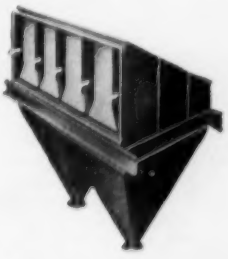

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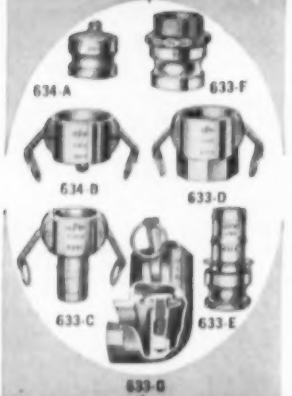

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lined in 6-pp Bulletin V-112. Includes cutaway view showing design features, standard materials table, and a table of standard pump valve sizes. Sims Pump Valve Co., Inc.

261 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed and illustrated. Crane Co.

262 Steel Gate Valves — Four types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 C, 12 pp. Material specifications, dimensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

263 Valve Data — This loose-leaf notebook contains a collection of company's bulletins on its line of valves for control of air, gas, liquids and solids. It features complete operating, design, dimensional and specification data on butterfly, slide, automatic and proportioning valves, and is profusely illustrated with photos, drawings and diagrams, highlighting valve design and construction. W. S. Rockwell Co.

264 Industrial Valves — Condensed Catalog 105, 28-pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

266 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, as well as trouble-shooting and repair. Armstrong Machine Works.

267 Steam Trap Selector — Twelve-pp Bulletin T-9 is designed specifically to aid in selection and application of steam traps on chemical processing equipment. Features a foldout piping diagram for 22 pieces of typical processing equipment — each showing recommended steam trap and piping arrangements. Also contains selector tables. Yarnall-Waring Co.

ELECTRICAL EQUIPMENT

269 Testing Instruments — Bulletin 19-56, 16-pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric tests sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

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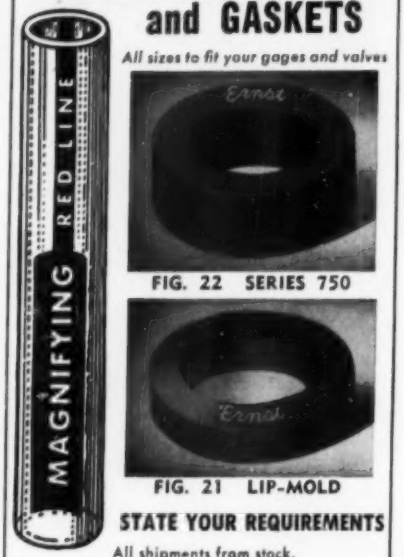

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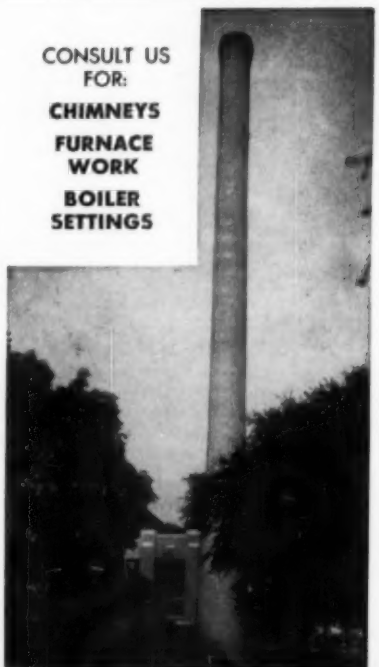

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270 Industrial Systems — Bulletin GED-3039, 48 pp, gives information on distribution system planning. Features, advantages, application, operation and other data on system-engineered equipment for industrial power distribution, including switchgear, unit substations, switchboards, transformers, busways, wire and cable, conduit products, voltage regulators, capacitors, circuit breakers, safety switches, panelboards, controls, motor controls, motors, turbines, rectifiers, and wiring devices are covered. General Electric Co.

271 On Copper Conductors — Publication C-25, 62 pp, is designed to help make the selection of bus conductors easier. Included in booklet are tables regarding such shapes as channels, ventilated square tubes and round tubes. There are tables for other rigid bus conductor shapes, also data on bare copper wire and cable as well as commonly used alloy wires. Also provided is a general discussion of copper, its physical and electrical properties. Photos illustrate many installations. The American Brass Co.

272 High Capacity Fuses — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of 600 to 5000 amp. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

OTHER EQUIPMENT

273 Product Guide — Manufacturing facilities for company's line of steam turbines, turbine generators, ship propulsion units, feed pumps, centrifugal compressors, blowers, centrifugal pumps, reduction gear, and other products are described in this profusely illustrated 50-pp catalog. Photos show manufacturing procedure. De Laval Steam Turbine Co.

274 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

275 Conveyor Belt Chart — Engineering data for standard conveyor belt construction is given in this chart and accompanying sheet. Strength characteristics of eight popular ply and material combinations of conveyor belt constructions are provided. Each property is printed on the chart in a different color to facilitate comparison. Quaker Rubber Corp., Div., H. K. Porter Co., Inc.

276 Filter Underdrains — Information on filter underdrains and underdrain blocks is presented in two new bulletins. No. 901-B, 8 pp, describes the primary and secondary distributing system, typical installations, performance and specifications. Bulletin 6220-B covers various types of filter underdrain blocks. Infilco Inc.

277 Turbine Speed Control — Thirty-pp wire-bound Bulletin H-21 is titled "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify the operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

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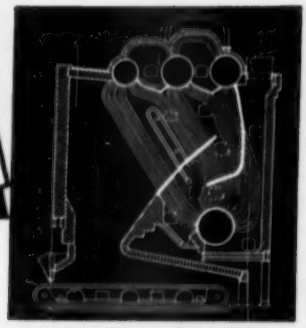

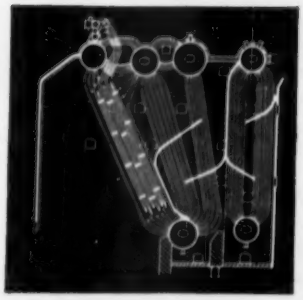

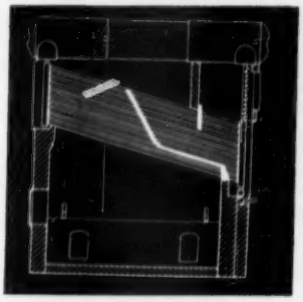

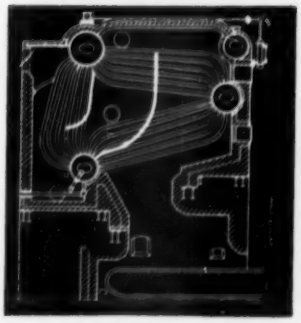

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278 On Chemical Cleaning — This series of seven folders covers the intangibles behind the chemical cleaning service offered by the company, such as training of cleaning specialists, accepted cleaning methods, safety consciousness, research, chemical cleaning equipment and service. Dowell Inc.

279 Duct Insulation — Engineering data and application instructions for company's semi-rigid, spun mineral wool duct insulation are presented in this informative bulletin. Thermal and sound absorption characteristics are presented in tabular form and physical, chemical, mechanical and handling properties are described. Baldwin-Hill Co.

280 Sectional Condenser — Bulletin 131 shows benefits of sectional-design refrigeration condensers for 100 to 240 tons refrigeration capacity and explains their functions with diagrams and installation photos. A cutaway shows component parts. Niagara Blower Co.

281 Sheet and Plate Fabrication — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

282 Nuclear Reactor Data — This 18-pp booklet lists significant data on every nuclear reactor known to be built or under construction in the world, including six in Russia. Material for the study was gathered from a wide variety of sources. A chart, listing reactors built since the first one in Chicago, and including those partially constructed or definitely planned and engineered for future construction, is included. Chart shows up to 50 principal characteristics of each reactor, including function and important technical features. Raytheon Mfg. Co.

283 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

284 Heat Transfer Apparatus — Condensed Bulletin HT-1 highlights representative products in company's line of heat transfer equipment. Includes oil heaters and coolers, strainers, evaporators, heat exchangers, radiafin air coolers, tubes, pipes, and coils. Cross-section views of typical units are shown; brief descriptions given. Schutte and Koerting Co.

285 Centrifugal Dust Collector — Twelve-pp Bulletin 100 introduces the Cyclo-trell multiple tube dust collector which operates on centrifugal collection principles and incorporates new features to boost collection efficiency and gas handling capacity. An illustrated explanation of operation and construction of this collector is accompanied by collection efficiency and capacity nomographs. Tables give design data for six sizes, from three to 20 tubes. Research-Cottrell, Inc.

286 Corrosion Control — Treatment of industrial equipment to control corrosion cannot be a hit-and-miss proposition cautions this 6-pp folder. Examples are given of optimum control measures that may avoid costly, unsound treatment procedures, including minor physical or operating changes. Hall Laboratories, Inc.

287 Flexible Ball Joint — Catalog 215-B, 20-pp, describes advantages of company's flexible ball joints for use in piping for power, process, heating, chemical, construction, or hydraulic service. Includes engineering specifications and data on the standard 300 lb series and the series 600. Screwed, flanged and welding end joints are listed, as are insulating joints and jacketed joints for handling asphalt and other liquids that solidify unless heated. Barco Mfg. Co.

288 Regulating Valves — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured-body engineered for high capacity at low pressure drop. Leslie Co.

289 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical and complete, and points out how it improves steam quality and reduces maintenance. National Aluminate Corp.

CLASSIFIED ADVERTISING

FOR SALE

50 K.W. Used M.G. Set — G. E. Manufacture Generator 115/230 volts — 3 wire — coupled to squirrel cage motor — 220 volts — 3 phase 60 cycles — 1160 R.P.M. — Mounted Structural Steel Base — balancing transformer — D.C. panel and instruments — Reduced voltage motor starter good condition — f.o.b. Gardiner — $2,000.00. Write for further details to YELLOWSTONE PARK COMPANY, *Engineering Department*, Gardiner, Montana.

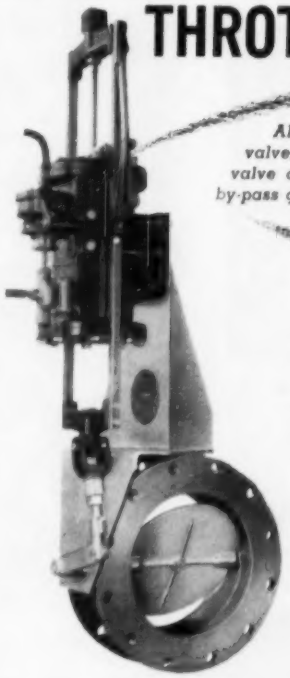
POSITION VACANT

Watch Engineer for municipally owned electric generating plant. Required preparation: High school graduate, supplemented by study along mechanical engineering lines, preferably with one or two years college work, and at least five years experience in a power plant. Box 1720, POWER ENGINEERING, 110 S. Dearborn St., Chicago 5, Illinois.

J. E. SIRRINE COMPANY
Engineers
Design and Supervision of Steam and Hydro-electric Power Plants, Industrial Plants, Mechanical and Operating Surveys, Appraisals • Plans • Reports
Greenville, South Carolina

Master GLASSES
MAGNIFYING
HIGH PRESSURE GASKETS
All sizes to fit your gages
ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

THROTTLES HOT GASES



All stainless steel 10" butterfly valve, with air cylinder operator and valve disc positioner, for throttling by-pass gases at 1200°F.

This is but one of many W. S. Rockwell standard and special flanged butterfly and wafer butterfly valves that meet any condition of pressure, temperature, corrosion or abrasion. Made in sizes from 4" to 144" of any metal, rubber-covered synthetic resin or glass-coated metal. For regulating, throttling or shut-off of air, gases, liquids or solids, no matter how "tough" the operating conditions. Minimum pressure drop. Non-clogging. Self-cleaning. Furnished with any manual or automatic operators. Write for Catalog.

W. S. ROCKWELL
Butterfly Valves

W. S. ROCKWELL COMPANY
ROCKWELL SINCE 1888 BUILT
BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES
2947 ELIOT STREET • FAIRFIELD, CONN.
Sales Representatives in Principal Cities

For more data circle 555 on Post Card

KOR

FUEL OIL CONDITIONER

pronounced "core"

MORE THAN A SLUDGE SOLVENT

Additives that simply take care of sludge problems are not enough. A complete treatment is needed to treat the thermal side of boilers as well as to dissolve all sludges.

KOR IS A COMPLETE TREATMENT

SEND FOR BULLETIN 1515544

READ ALL ABOUT IT

LEARN HOW TO OBTAIN MORE STEAM OR MORE HEAT WITH LESS OIL AT LESS COST THAN EVER BEFORE

• *REMEMBER* •

KOR IS SAFE TO USE

KOR CORPORATION

Division of Oxi Corporation

600 WEST 9th AVENUE, GARY, INDIANA

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FREE TEST SAMPLE CAN

shows how C-5 solves "HIGH-TEMP" THREAD PROBLEMS!

Prove it to your own satisfaction that C-5 ENDS STUD SEIZING AND GALLING EVEN AT 1800°F

Leading plants are now using C-5 for boiler, manhole, handhole and face plate studs, turbine header studs, flange bolts on high temperature valves, steam lines, pumps, etc., and other applications where temperatures are up to 1800° F.

Fel-Pro's exclusive C-5 colloidal copper formula "copper-plates" metal . . . gives maximum cushioning and protection to 1800° F. without breakdown.

C-5 prevents galvanic action—eliminates pitting even where dissimilar metals are joined . . . protects all threaded surfaces, insuring their repeated re-use!

Write today for your FREE Test Sample CAN. Felt Products Mfg. Co., 1567 Carroll Ave., Chicago 7, Ill.

fel-pro C-5 "HIGH-TEMP"

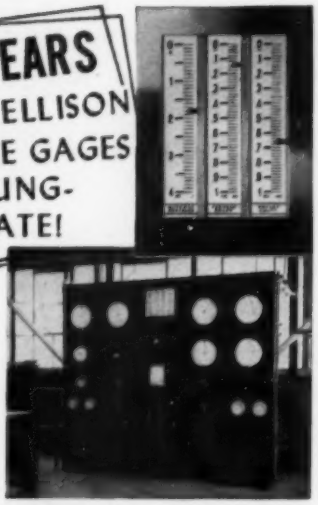
√ Prevents Stud Breakage
√ Ends Stainless "Pitting"
√ Reduces Torque
√ Speeds Disassembly

ANTI-SEIZE THREAD COMPOUND

For more data circle 558 on Post Card

25, 35, 40 YEARS SERVICE-AND ELLISON STRAIGHT LINE GAGES ARE STILL YOUNG-STILL ACCURATE!

1910
1920
1930
1940
1950



Reports from the field indicate that many of the first ELLISON Straight Line Draft Gages installed are still giving highly satisfactory performance. Ellison Gages give accurate readings—non-parallax pointers. Long lasting, positive, highly responsive mechanism. Bell type or Diafram type. Models for any panel board arrangement. Send for Bulletin 122—Bell type; Bulletin 124—Diafram type.

ELLISON DRAFT GAGE CO., INC.

550 W. MONROE ST. Since 1896 CHICAGO 6, ILL.

The Ellison Line Also Includes:

Draft Gages, Bell and Diafram—Inclined Draft Gages—Portable Inclined Vertical Tube Gages—Vertical Tube Gages—Oil, Heavy Liquid and Mercury—Single and Multi-Tube-Saturator Gages—U Gages—Stationary and Portable—Air Filter Gages—Dial and Inclined Tube Types—Pitot Tubes—U Path Steam Calorimeters—Portable Gas Analyzers-Orsat Type

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Sign Your

DECLARATION OF INDEPENDENCE

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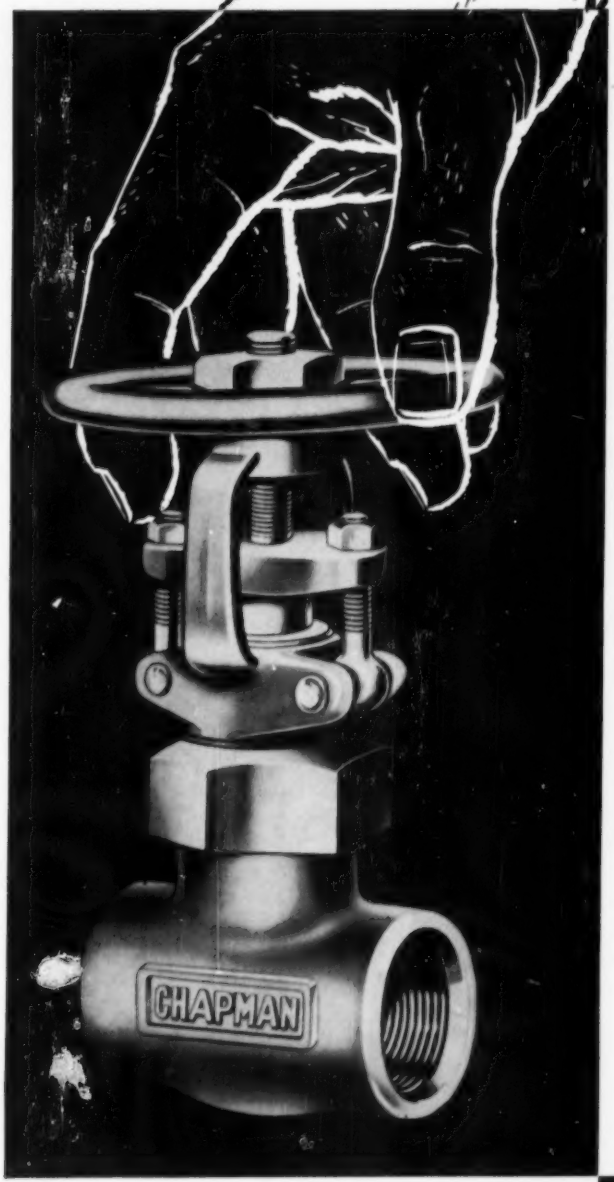
Buy U. S. Savings Bonds!

TURN ON PERFORMANCE
...Turn off your Costs!



CHAPMAN LIST 960
Forged Steel Gate Valves

This is an open and shut case of top performance and lowest maintenance. To begin with, the wedge faces on Chapman List 960 are *super* hard. In fact, they're hardened to 800 Brinell by Chapman's *exclusive Malcomizing process.* They can't seize. They can't gall. The seat rings are hardened stainless steel. They last longer and, when necessary, they're very easy to replace.

There are no full-pressure repacking difficulties. Bolted follower on the outside screw rising stem design has no threads that are exposed.

Is it any wonder there are more Chapman List 960 valves on more jobs than any other small forged steel gate valve? They stand up perfectly under conditions ranging from 380 psi at 1000°F to 2000 psi at 100°F. You use Chapman List 990 valves for higher pressures. Sizes for List 960 are from ¼″ to 2″. You can have rising stem with yoke or rising stem with inside screw. And the Bonnet joint is either gasketed or ground metal-to-metal, depending upon your needs.

To take a good look at the ways to cut your valve costs, take a good look at our Catalog 10. Write, today, for your copy.

The CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASS.

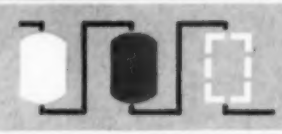
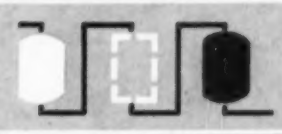
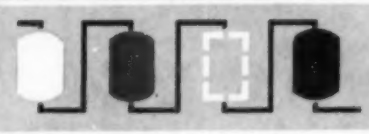
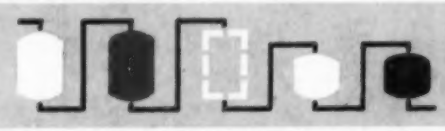
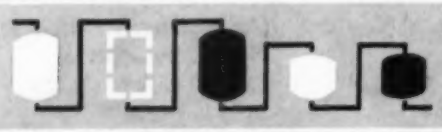
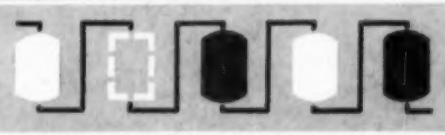
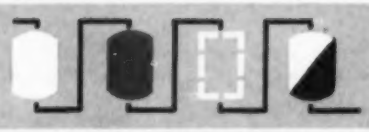
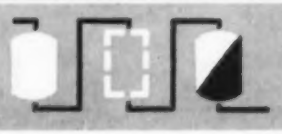
For more data circle 560 on Post Card

9 ways to demineralize water

(BY ION EXCHANGE)

KEY:

- **Hydrogen Cation Unit** — Removes metallic cations such as calcium, magnesium, sodium. Regenerated with sodium for simple water softening.
- **Weakly Basic Anion Unit** — Removes strongly ionized acids such as sulfuric, hydrochloric, nitric.
- **Strongly Basic Anion Unit** — Removes strongly ionized acids, also weakly ionized acids such as silicic and carbonic.
- **Mixed Bed Unit** — Contains both Hydrogen Cation and Strongly Basic Anion Exchangers, intimately mixed.
- **Degasifier** — Optional. Reduces load on Strongly Basic Anion Exchanger by removing free CO_2 brought in by raw water or developed in cation unit.

A	 Effluent Conductivity—10 to 20 micromhos (no silica reduction)	Uses low-cost anion exchanger and anion regenerant (soda ash). Typical use—removing soluble salts from water for ceramic mixes and slips or from rinse waters used before painting, mirror silvering, etc.
B	 Effluent Conductivity—same as A. Silica content—0.02 to 0.15 ppm.	Used for treating feedwater for boilers in general range of 600 to 1400 psi. Also (without degasifier) for removing impurities from plating baths and recovering chromate from plating rinses.
C	 Same effluent as B.	For raw water with high sulfate and chloride content. Low-cost Weakly Basic Anion Exchanger removes major portion of electrolyte load. Countercurrent regeneration of anion units reduces operating costs.
D	 Effluent Conductivity—3 to 5 micromhos. Silica same as B.	For same type of raw water as C. Countercurrent regeneration of both cation and anion units cuts operation costs.
E	 Effluent Conductivity—1 to 5 micromhos. Silica same as B.	For waters where alkalinity is a major part of the anion content. Polishing units require infrequent regeneration. Produces, at low cost, low-solids feedwater suitable for high pressure boilers (over 1400 psi).
F	 Same effluent as E.	High flexibility of operation. Can operate in parallel for peak flows. Can maintain service flow during regeneration of either pair of units.
G	Effluent Conductivity—less than 1 micromho. Silica same as B.	Produces effluent of extremely high quality. Suitable for "super critical" pressure boilers and atomic reactors. (Initial and operating costs are usually higher than for separate anion and cation units.)
H	 Same effluent as G.	For raw water with high sulfate and chloride content. Two-step demineralizer reduces load on Mixed Bed unit, cuts operating cost. (Strongly Basic Anion Exchanger is used in place of Weakly Basic where raw water has high silica and alkalinity.)
I	 Same effluent as G.	Recommended where alkalinity of raw water is high. Cation unit and Degasifier reduce load on Mixed Bed unit, cut operating costs.

All of the above systems, with equipment and resins made by Permutit, are in commercial use. Other combinations are possible—also use of special ion exchangers such as PERMUTIT SK for separating uranium oxide from other metallic oxides in ore.

Most of these systems (C and higher) are used almost exclusively for demineralizing feedwater for high-pressure boilers . . . but the list of possible applications in other fields is growing.

If you have a problem ion exchange might solve, we'll be glad to study it with you and bring you the benefits of this experience. Address: The Permutit Company, Dept. IPE-1, 330 West 42nd St., New York 36, N. Y.

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